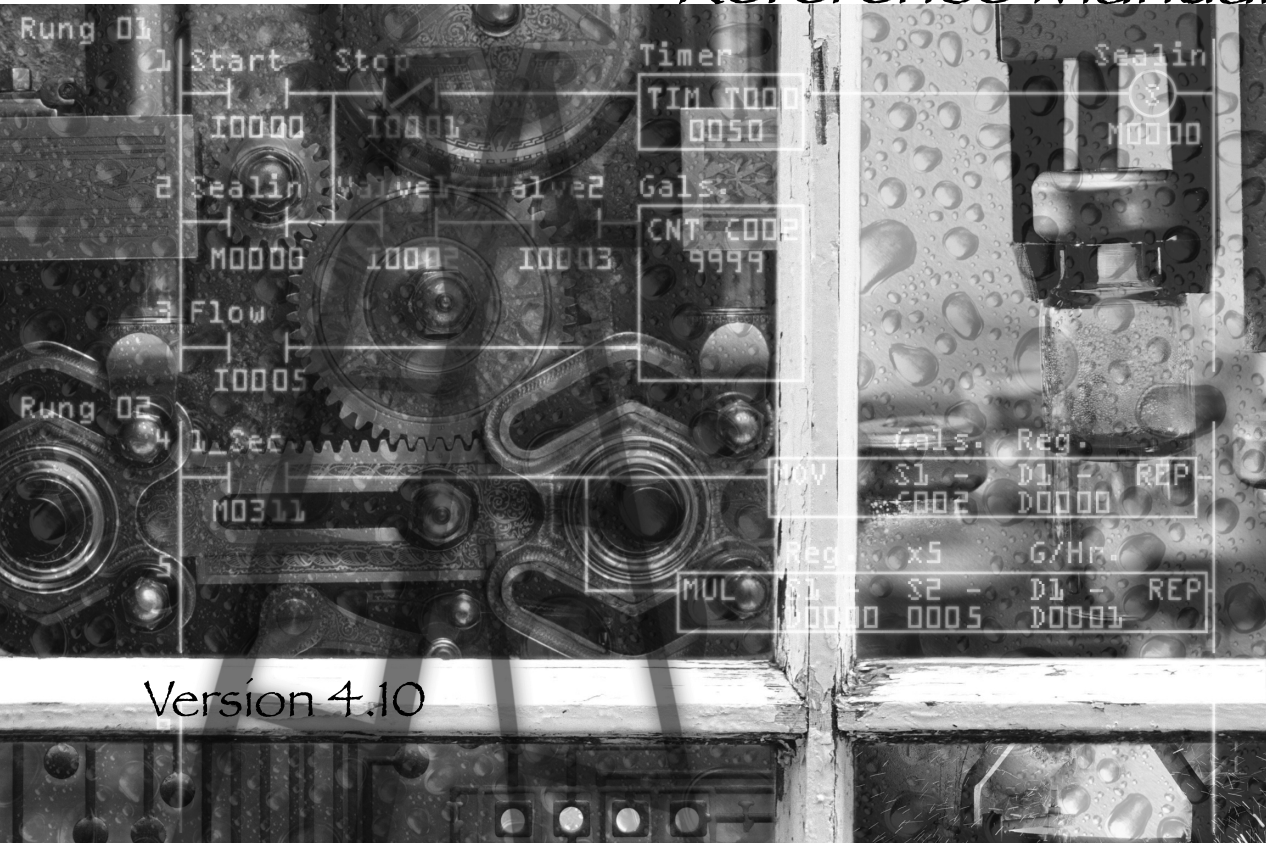


WindLDR™ Reference Manual



idec

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1. INTRODUCTION

Welcome to IDEC's WindLDR™ configuration software package: where logic and intuition converge! WindLDR is a true Windows application, with WYSI-WYG (what you see is what you get) ladder editing.

The *WindLDR™ Reference Manual* provides an introduction to programming IDEC's full line of programmable logic controllers (PLCs) using IDEC's Windows-based ladder logic software. Use this manual as a reference for information about your software package.

NOTE: Chapter 9, Chapter 10, Appendix 1, and Appendix 2 are geared toward the Micro series of PLC's. For similar instructions and details on the FA Series, the Open Net Controller (ONC), and MicroSmart PLC's, please refer to the corresponding hardware manuals.

The *WindLDR™ Tutorial* presents a simple, quick-step approach to get you up-and-running with a few basic applications. The *Tutorial* is a perfect introduction to WindLDR or to programming your first PLC.

Using WindLDR can greatly increase productivity. Its easy-to-use features and ability to quickly create ladder diagrams will save your company time and money.

WindLDR provides programming configuration for IDEC's full line of PLCs and creates a bridge between older application software and hardware.



This chapter provides:

- A general description of the WindLDR software features
- Documentation conventions used in the WindLDR manual set
- Steps to a successful software installation

WindLDR Version 4.0 Features

WindLDR features cut and paste editing, enhanced on-line monitoring, and a **multi-level undo** option which is limited only by available memory. With the flexible **Find String** feature, WindLDR searches for a variety of text in a number of ways, making it easier to handle large ladder files.

Use the menus of the **context-sensitive right mouse button** for convenient access to the most commonly used commands. Toolbars, ladder file characteristics, and other program features can be **customized** to the user's preferences. The **Tag Editor** is a powerful way to access and edit all your coil data in one convenient place.

Printing your ladder diagrams is a snap with fully customizable formatting and convenient **Print Preview**, **Cross Reference**, and **Tag Name** features to fine-tune your documents. WindLDR can display **mnemonics** and/or **machine code** with your ladder files. The **monitoring** feature enables you to debug and observe real-time PLC functionality, right from your computer!

You no longer need to remember obscure codes and abbreviated commands—with WindLDR, it's just a simple **drag and drop** operation to create any instruction.



WindLDR allows you to open **multiple ladder files** so you can compare and reuse them instantly, even if they are written for different PLCs! The **PLC Status** dialog provides valuable information at a glance, without remembering all those complicated function codes.

The **Point Write** dialog allows you to change the preset values of operands without having to stop monitoring and recompile your ladder file. The **Direct Monitor** and **Batch Monitor** dialogs display the values of data in real-time. **Coils** can be edited simply by double-clicking on them; no need to create new coils from scratch. Along with IDEC's quality PLCs, you get the **service and software support** you expect.

WindLDR is compatible with Windows 95, Windows 98, Windows 2000, and Windows NT 4.0. So, transferring files across **different platforms** is quick and easy.

WindLDR Package

When purchasing WindLDR software packages, the following items are included:

- WindLDR configuration software on CD-ROM
- *WindLDR™ Reference Manual*
- *WindLDR™ Tutorial*
- WindLDR software registration card
- IDEC Corporation Software End User License Agreement





Document Conventions

Throughout this manual, you will find icons and key combinations specific to the instructions. These particular documentation conventions are explained as follows.

While all keyboards are set up uniquely, the ENTER, RETURN, or NEXT key is always written as [ENTER] in this manual.

Additionally, referencing a common button, such as OK, Cancel, or Help, is noted as the OK button.

In text, when an icon is available for use, it will be noted as: click either the  - or  button.

Action items are denoted by the following arrow graphic.



Alongside this symbol, the corresponding action items always print. Follow these directions to easily complete all procedures.

Action items requiring a specific entry will be printed, for example, as enter: 1234 at the prompt.

Menu instructions are separated by an arrow (→). For example, “Click **Configure** → **PLC Selection**” indicates for you to click **Configure** from the **Menu Commands** toolbar and then to click **PLC Selection** from the drop down menu.

The majority of the WindLDR screens and dialog boxes are applicable to all PLC types. However, some screens and dialog boxes differ depending on the PLC type. Unless there is a difference among PLC types, all screen and dialog box examples in this tutorial will reflect the Open Net Controller (ONC) PLC.

Within this reference manual, *Chapters 3 through 8* describe the options available from the **Menu Commands** toolbar. *Chapter 9* includes details about all the basic and advanced instructions which allow you to program and edit your ladder. Finally, *Chapters 10 and 11* explain the advanced instruction, mainly applicable to the Micro PLC series. For details on other PLC's, like the FA series, the ONC, and the MicroSmart, please refer to the appropriate user's manual.

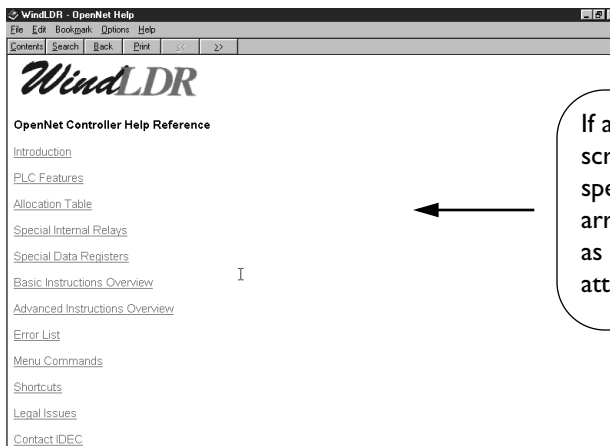
Basic instructions are applicable to all PLC types. However, advanced instructions are only applicable to certain PLC's.

On-Line Help

The detailed set of Help screens is like having an entire library of PLC manuals at your fingertips, complete with easy access and context-sensitive help about everything from WindLDR functions to PLC hardware.



To access On-Line Help, click the **?** icon in the menu bar at any time.



If any information on the screen displayed is of special interest, then an arrow and a balloon, such as these, will direct your attention to that point.

CLIP and CUBIQ Shortcuts

Many shortcut elements from CLIP and CUBIQ are present in WindLDR. So, if you are familiar with these shortcut keys, they are also available with this program. For example:

- Typing characters while in the editing mode will automatically bring up the **Coil Selection Dialog** screen with the first letter of the command abbreviation highlighted.
- You can easily draw ladder lines in WindLDR by holding the [SHIFT] key and using the arrow keys to draw.
- Ladder lines can just as easily be erased by holding down the [CONTROL] key and using the arrow keys to erase.

WARNING: Unlike CLIP and CUBIQ, WindLDR uses rungs (blocks of logic) in building ladder programs. *Users must exercise caution and keep the size of the rung to a minimum.* Large and tedious rungs produce unpredicted errors and problems in WindLDR.

Technical Support

Registered users of IDEC's WindLDR software are entitled to telephone support. To qualify, complete the enclosed registration card and return it to IDEC. For assistance, call 1-800-262-IDEC (4332) extension 7526 to contact the PLC Technical Engineering Group.

To contact us through E-mail, write to *support@idec.com* via the Internet.



Installing WindLDR Software

The WindLDR software is supplied on CD-ROM and is accessed from the PC after installing the files onto the hard disk. The WindLDR destination directory name is configurable but defaults to **Program Files\idec\WindLDR3.0**. This directory holds all of the executable files.



To install the WindLDR software:

1. Insert the CD-ROM into the PC's CD-ROM drive.
2. In Windows 95, 98, 2000 and NT 4.0, click the **Start → Run** from the task bar.
3. Enter **D:\setup.exe** in the **Run** dialog box. The "D" indicates the CD-ROM drive. Your PC's CD-ROM drive may be designated by another letter.

A series of screens will display to walk you through the installation procedures.

4. When prompted for the destination directory, you can use the default directory, **C:\Program Files\idec\WindLDR4.0**, or enter another destination directory for the installation files.

The system creates the IDEC WindLDR directory automatically. To activate the WindLDR configuration software, create a shortcut to the WindLDR executable file and double-click on the icon that is created.



Hardware/Software Recommendations

WindLDR will run on a Pentium based PC running Microsoft® Windows® 95 or 98 with at least 24MB of available RAM and Windows® 2000 or NT4.0 with 32MB of available RAM.



2. WINDLDR LEGENDS

Throughout the WindLDR software, a number of quick keys, icons, and allocations exist. This chapter will demystify their naming conventions and their corresponding functionality.

Quick/Editing Keys

Quick keys are keys on your PC's keyboard that, when pressed, execute a consistent command. The functions of the following quick keys are explained as follows.

Editing Keys

Key	Description
Arrow Down	+ [SHIFT] Draw a vertical line downward; move the cursor one position down + [CONTROL] Erase the vertical line starting at the current position; move the cursor one position down
Arrow Left	+ [SHIFT] Draw a horizontal line one position left + [CONTROL] Erase the horizontal line one position left
Arrow Right	+ [SHIFT] Draw a horizontal line one position right + [CONTROL] Erase the horizontal line one position right



Arrow Up	+ [SHIFT] Draw a vertical line upward; move the cursor one position up + [CONTROL] Erase the vertical line ending at the current position; move the cursor one position up
Backspace	Move cursor one space left and delete
Del	Delete the item at the cursor
End	Go to the end of the current line
End + Control	Go to the end of the ladder
Home	Go to the beginning of the current line
Home + Control	Go to the beginning of the ladder
Page Down	Scroll down one page
Page Up	Scroll up one page

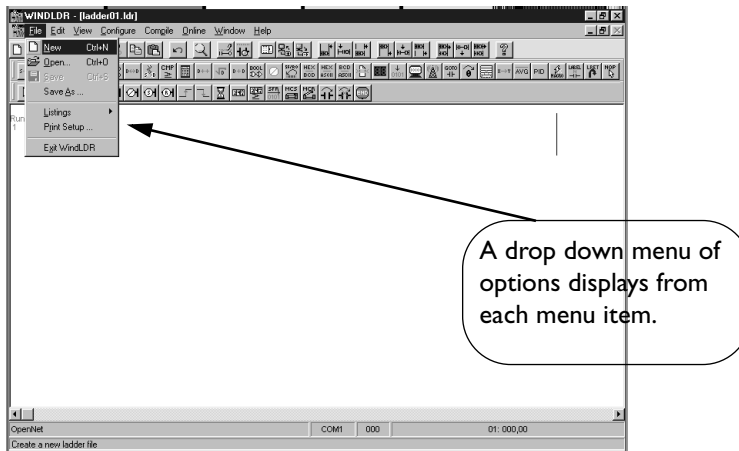


Icons

The **Menu Commands** toolbar is displayed in a banner at the top of your PC screen with the following main options available:

File Edit View Configure Compile Online Window Help

Each of these options, when selected, displays a drop-down sub-menu of alternatives for selection.

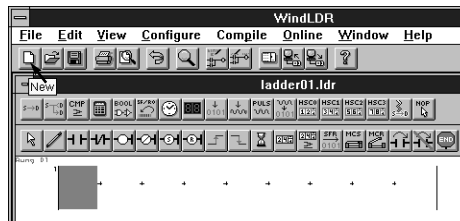


Additionally, rows of icons display from the ladder editing screen. When no files are open, only the top row of icons displays. When a file is open, multiple rows of menu bar icons, depending on the PLC type, are displayed.

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Clicking any of these icons provides quick access to the commands as listed below. The top row of icons highlight the most common tasks associated with the menu bar. The lower two rows execute the basic and advanced instructions specific to programming, editing, and debugging the actual ladders.







By positioning the cursor over any of the icons, a pop-up tip message will display the icon's function.



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Menu Commands Toolbar Icons

	New
	Open
	Save
	Print
	Print Preview
	Cut
	Copy
	Paste
	Undo
	Find

	Edit Rung Comment
	Tag Browser
	Select PLC
	Upload Program
	Download Program
	Help

NOTE: For complete instructions about the New, Open, Save, Print, and Print Preview options, refer to *Chapter 3, File Menu*.

For complete instructions about the Undo, Find, and Edit Rung Comment



options, refer to *Chapter 4, Edit Menu*.




















For complete instructions about the Select PLC option, refer to *Chapter 6, Configure Menu*.

For complete instructions about the Upload Program and Download Program options, refer to *Chapter 8, Online Menu*.

For complete instructions about the Help option, refer to page 1-5 and to *Chapter 9, Editing the Ladder*.























Advanced Instruction Icons

	Move		Pulse
	Indirect Move		Analog to Digital
	Compare		HSC0: Single Stage Comparison
	Binary Arithmetic		HSC1: Multi-Stage Comparison
	Boolean		HSC2: Pulse Output Control
	Bit Shift/ Rotate		HSC3: Gate Control
	Clock/ Calendar		Transmit/ Receive (available w/ Micro ³ C only)
	Display		Macro
	Digital Read		No Operation
	Analog Read		



Basic Instruction Icons

	Select Coils
	Draw Line
	Erase/Delete
	Normally Open
	Normally Closed
	Output
	Output Not
	Set
	Reset
	Single Output Up
	Single Output Down

	Timer
	Counter
	Counter/ Timer Compare
	Shift Register
	Master Control Set
	Master Control Reset
	Jump
	Jump End
	End



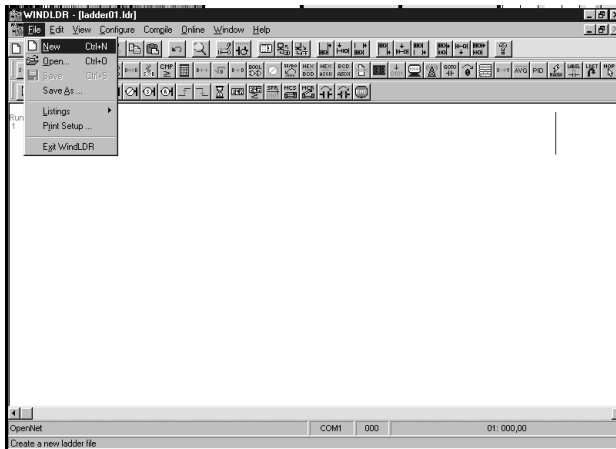
NOTE: For complete instructions about these basic instruction icons, refer to *Chapter 9, Editing the Ladder*.

3. FILE MENU

The available menu options display on the menu bar at the top of the screen. The first option available is the File menu which allows users to:

- Select among existing ladder files
- Create new ladder files
- Save or rename open ladder files
- Print preview and print files
- List and print function area settings, program compare, cross reference, and tag names
- Exit out of the WindLDR software program

The following options may be selected:




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File → New

Selecting the **New** option from the **File** menu opens a new, empty WindLDR ladder file. This newly created file is numbered to reflect its order of creation.


The new file format is determined by the default or current PLC settings. A dialog box will not display with this option. To name the ladder file, select the **Save** or **Save As** option from the **File** menu.

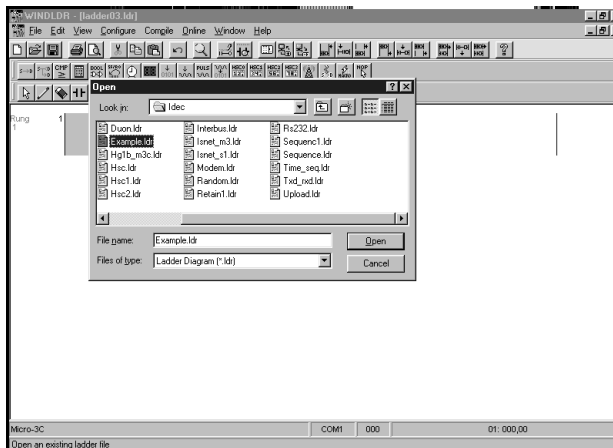
You may also click the toolbar button: 

NOTE: You may open up to 11 ladder files at once.

File → Open

Selecting the **Open** option from the **File** menu opens an existing WindLDR ladder file, complete with PLC settings and ladder preferences.

You may also click the toolbar button: 



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File Name:

Within the **Open** dialog box, select a file name by clicking to highlight it, or enter the desired ladder file into the **File Name:** field.

List Files of Type:

All ladder files should have the file extension `.ldr`.

Directories:

Unless otherwise specified, the default directory of all ladder files is `C:\windldr`. If you wish to access another directory, use the scroll bars and your mouse button to highlight the appropriate directory.

Drives:

Use the arrow icon and your mouse button to select among available drives within this field. In general, the “c” drive is your hard drive and the “a” drive is your floppy drive.



Once the appropriate file name, drive, and directory have been selected, click the **OK** button.

To back out of this option without opening a file, click the **Cancel** button.

NOTE: You may open up to 11 ladder files at once.

File→Save

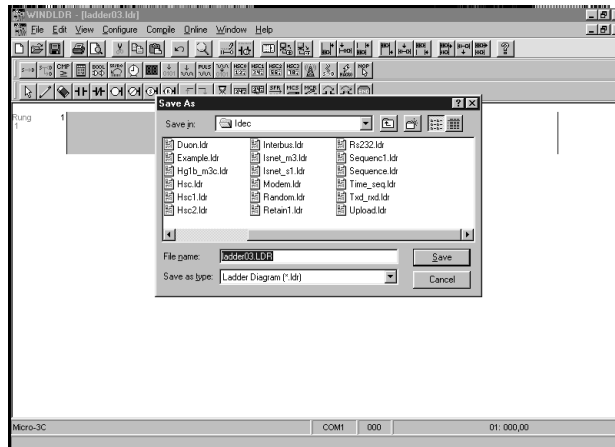
Selecting the **Save** option from the **File** menu saves the active WindLDR ladder file, complete with PLC settings and ladder preferences.

You may also click the toolbar button:



File → Save As

Selecting the **Save As** option from the **File** menu saves the active WindLDR ladder file under a new file name, complete with PLC settings and ladder preferences.



File Name:

Within the **Save As** dialog box, enter a file name into the **File Name** field. The default file name reflects its order of creation.

Save File as Type:

All ladder files must have the file extension **Ladder Diagram** [***.ldr**].

Directories:

Unless otherwise specified, the default directory for all ladder files is **C:\windldr**. If you wish to access another directory, use the scroll bars and your mouse button to highlight the appropriate directory.

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Drives:

Use the arrow icon and your mouse button to select among available drives within this field. In general, the “c” drive is your hard drive and the “a” drive is your floppy drive.




Once the appropriate file name, drive, and directory have been entered, click the OK button.

To back out of this option without saving or renaming the file, click the Cancel button.

File → Listings → Ladder


Selecting the **Listings** option from the **File** menu allows the user to view/print the following features: **Ladder**, **Ladder Preview**, **Function Area Settings**, **Program Compare**, **Cross Reference**, and **Tag Name**.

To simply print the ladder program, choose **Ladder**, then click **OK**.

You may also click the toolbar button: 

File → Listings → Ladder Preview

Selecting the **Ladder Preview** option from the **File → Listings** menu displays the pages of the ladder file as they would appear when printed. You may view one or two pages at a time.

You may also click the toolbar button: 

Depending upon the printer device you have installed, the **Print Preview** dialog box will reflect the printer's configuration. Follow the instructions enclosed with your printer for specific printing instructions.

File → Listings → Cover Page

Selecting the **Cover Page** option from the **File** menu will allow you to create a cover page for the project and print it separately from the ladder screen.

File → Listings → Function Area Settings

Selecting the **Function Area Settings** from the **File** menu will allow you to view certain PLC settings with an option to print them.

File → Listings → Program Compare

Selecting the **Program Compare** option will allow you to compare two code files: the uploaded file (from a PLC) and the working file for match or mis-match.

File → Listings → Cross Reference

Selecting the **Cross Reference** option from the **File → Listings** menu will display the reference of all the operands of the ladder file in a Microsoft Notepad format, with the option to print it.

File → Listings → Tag Name

Selecting the **Tag Name** option from the **File → Listings** menu will display all the tag names in the ladder file in a Microsoft Notepad file, with an option to print it.



File → Print Setup

Selecting the **Print Setup** option from the **File** menu displays the options to select a printer, the page orientation, and the paper size. Additionally, you may change specific printer settings and the default printing device.

Depending upon the printer device you have installed, the **Print Setup** dialog box will reflect the printer's configuration. Follow the instructions enclosed with your printer for specific printing instructions.

File → Exit WindLDR

Selecting the **Exit WindLDR** option from the **File** menu ends the WindLDR program. You are given the choice to save any modified ladder files.



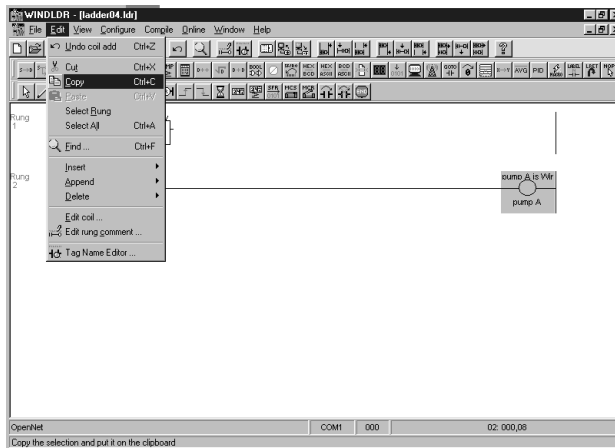


4. EDIT MENU

The second menu option available is the **Edit** menu which allows users to:

- Undo the last command
- Cut, copy or paste
- Select rung, select all
- Find a tag name, allocation number, or tag name comment within the open ladder file
- Insert, append or delete
- Edit a coil, rung comment or tag name


The following options may be selected:



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Edit → Undo

Selecting the **Undo** option from the **Edit** menu reverses the last editing action. Additionally, WindLDR allows multiple undos. Each time **Undo** is selected, the previous chronological action is reversed. Nevertheless, once a ladder file is saved, the **Undo** option is no longer available.

You may also click the toolbar button: 

Additionally, when the **Undo** option is selected from the **File** menu, the nature of the command which will be reversed displays.

Edit → Cut / Copy / Paste

Selecting the **Cut**, **Copy**, or **Paste** options from the **Edit** menu allows you to cut, copy or paste a coil, ladder line, rung or multiple rungs into the ladder file.

You may also click the toolbar buttons:



Cut



Copy



Paste

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NOTE: You may also use the keyboard to **Cut**, **Copy** and **Paste**. Use [CONTROL]+[X] to **Cut**, [CONTROL]+[C] to **Copy**, and [CONTROL]+[V] to **Paste**.

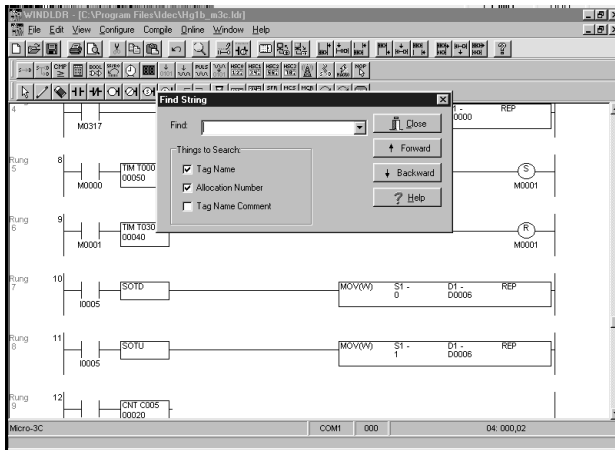
Edit→Select Rung / Select All

This option allows you to select a particular rung or all the rungs of a ladder file in order to Cut, Copy or Paste.

Edit→Find...

Selecting the **Find...** option from the **Edit** menu allows you to search for tag names, allocation numbers, and tag name comments.

You may also click the toolbar button: 



Find:

Enter the text for which you wish to search. Or, click the **Forward** or **Backward** buttons to the right of the **Find:** field, and select from the list of previous searches.

Things to Search:

Select one, two, or all of the search options (**Tag Name**, **Allocation Number**, and **Tag Name Comment**).

Examples of tag names are I1, Q4, T3, D30 and so forth. For a complete listing of available allocation numbers, refer to *Appendix 1: Allocation Number Table*.

Tag name comments are user-supplied comment strings for coils.



Once the appropriate text string and search option(s) have been selected, click either the **Forward** or **Backward** button. The **Forward** button will find the previous occurrence of the text string. The **Backward** button will find the next occurrence of the text string.

To back out of this option, click the **Cancel** button. To access on-line help, press the **Help** button.

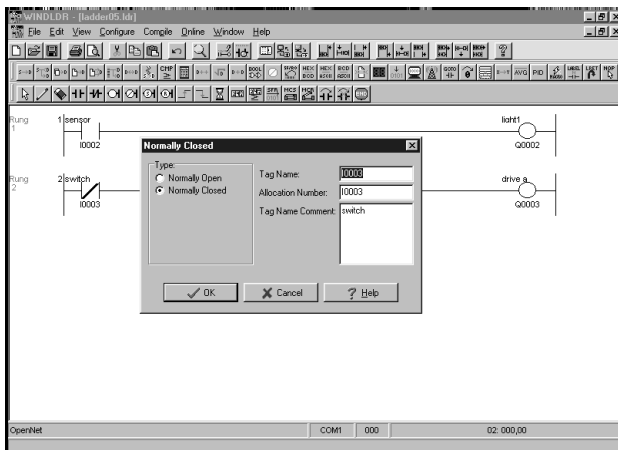
Edit→ Insert / Append / Delete

Selecting **Insert** allows you to insert a ladder line, column, or rung at any point in the program and in any location. Selecting the **Append** option allows you to append a ladder line, column or rung at any point in the program and in any location. Selecting **Delete** allows you to delete a coil, ladder line, column or rung at any time.

NOTE: You may also delete a coil, ladder line or rung by selecting it and using the [DELETE] button on your keyboard.



Edit → **Coil...**

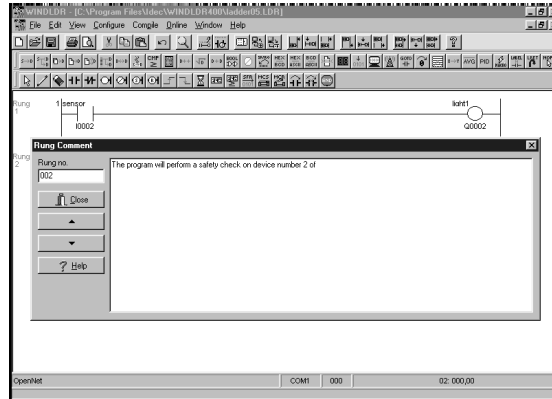
Selecting the **Coil...** option from the **Edit** menu accesses the editor related to the currently selected coil. Coils may also be edited by double-clicking on them within the ladder file.







After editing the coil, click **OK** to accept and save your changes.

Edit → Edit Rung Comment...

Selecting the **Edit Rung Comment...** option from the **Edit** menu allows you to edit the current rung comment, as well as to edit all rung comments by using the  and  buttons.



To enter a comment, **click within the text area** and begin typing. The comment entered is applicable to the number of the rung which displays in the upper left corner.

You may access and edit all rung comments by clicking the  and  buttons. The  button accesses the previous rung comment. The  button accesses the next rung comment.

Once all rung comments are entered, click **OK** to save your changes and to close the **Rung Comment** dialog screen.

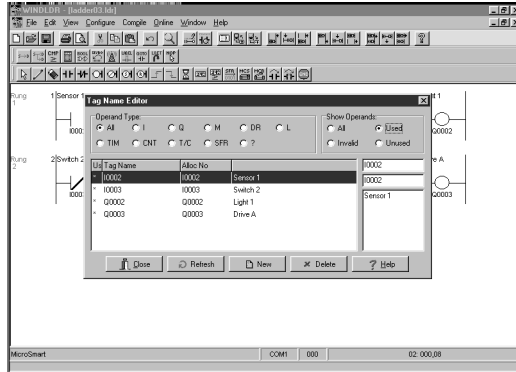
To access on-line help, press the **?** icon.

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NOTE: There is no limit to the number of characters you may use in the rung comments. Use as much text as you need.

Edit → Tag Name Editor...

Selecting the **Tag Name Editor...** option from the **Edit** menu provides a convenient way to find and edit coils in large ladder files. It is possible to scroll through coils based on operand type, tag name, allocation number, or comments.










To select a **Tag Name**, click on the entry to highlight it. Once one is selected, you may edit its tag name, allocation number, and tag name comment within the fields to the right. Use the top field to edit the tag name, the middle field to edit the allocation number, and the bottom field to edit the tag name comment.

Clicking on the various headings will rearrange the order of the tag names accordingly. To rearrange the tag names in ascending order, click on the **Tag Name** heading. To rearrange the allocation numbers in ascending order, click on the **Alloc No** heading. To rearrange the tag name comments in ascending order, click on the **Comment** heading.

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Use the following charts for the functions and definitions of the various options available within the **Tag Name Editor** dialog box.

Function Keys within the Tag Name Editor

<p>Close</p> 	<p>Exits the Tag Name Editor and returns you to the main window. Upon exiting the Tag Name Editor, any changes made will be saved.</p>
<p>Refresh</p> 	<p>If changes to the ladder are made, this option refreshes data in the editor. All editor changes immediately update the ladder. Changes include: tag names, allocation numbers, and tag name comments.</p>
<p>New</p> 	<p>Creates a new tag name. This button allows you to create all necessary tag names and assign allocation numbers and tag name comments to these tag names.</p>
<p>Delete</p> 	<p>Deletes the currently selected (highlighted) tag name. The changes are immediately adjusted in the ladder window.</p>
	<p>Access the On-Line Help page for the editor.</p>
	<p>Allows you to move to previous coils that have the same tag name. With this option, you can see if more than one coil has the same tag name.</p>
	<p>Allows you to move to the next coil that has the same tag name. With this option, you can see if more than one coil has the same tag name.</p>

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Field Descriptions within the Tag Name Editor

Operand Type

To specify the operand type, click the diamond next to the appropriate selection.

Once a type is selected, only the corresponding tag names will display.

All	Allows you to see all the operand types.
I	Allows you to see only the inputs used in the program.
Q	Allows you to see only the outputs used in the program.
M	Allows you to see only the internal relays used in the program.
DR	Allows you to see only the data registers used in the program.
L	Allows you to see all the link registers used in the program
TIM	Allows you to see only the timers used in the program.
CNT	Allows you to see only the counters used in the program.
T/C	Allows you to see both timers and counters used in the program.
SFR	Allows you to see only the shift registers used in the program.
?	Displays all valid operand types.



Show Operands

To display the operands based on type, click the diamond next to the appropriate selection. Once a type is selected, only the operand types will display.

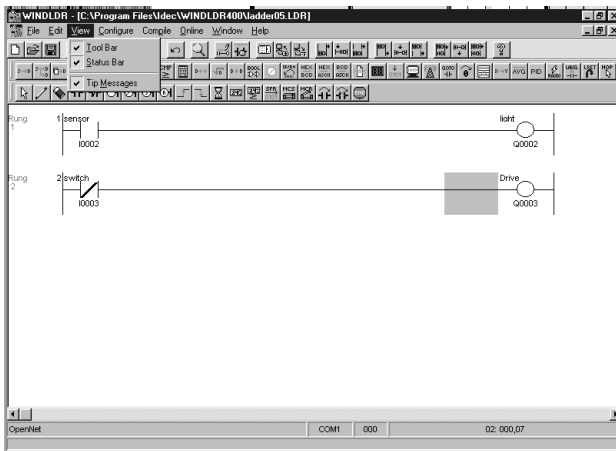
All	Allows you to see all operands based upon the operand type.
Invalid	Allows you to see all invalid operands.
Used	Allows you to see all operands which are in use.
Unused	Allows you to see all operands which are not in use.



5. VIEW MENU

The third menu option available is the **View** menu which allows users to adjust the views available while using WindLDR.

The following options may be selected:



View → Tool Bar

Checking and unchecking the **Tool Bar** option for the **View** menu toggles the main **Tool Bar** at the top of the display on and off.

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View→Status Bar

Checking and unchecking the **Status Bar** option from the **View** menu toggles the **Status Bar** at the base of the display on and off.

The status bar displays the program status, PLC type, communication settings, and the current cursor position (from left to right). The program status field displays tips about the command to which your mouse cursor currently points.

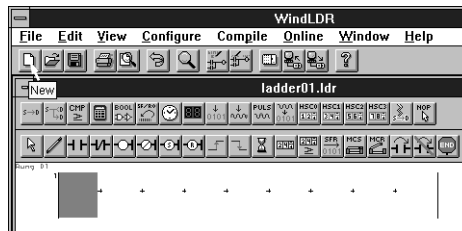
Double-clicking the PLC type field displays the **PLC Selection** dialog box.

Double-clicking the communications settings field displays the **Communications Settings** dialog box.

View→Tip Messages

Checking and unchecking the **Tip Messages** option from the **View** menu toggles the balloon help messages for the icons on and off.

When the **Show Tip Messages** option is enabled, pop-up balloon help is available. For example, by positioning the cursor over of the **New** icon, a pop-up tip message displays the icon's function: **New**.

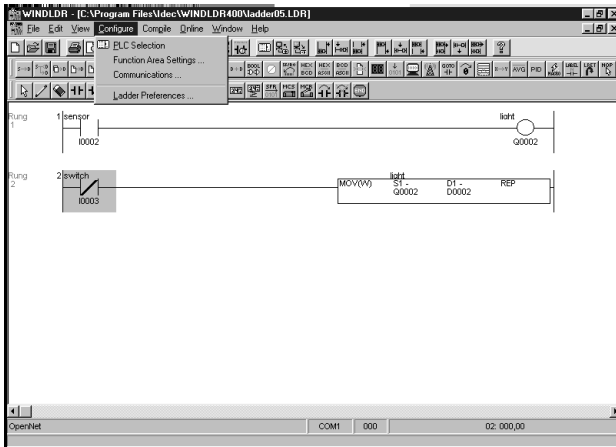


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6. CONFIGURE MENU

The fourth menu option available is the **Configure** menu which allows you to adjust the configurations and settings of your PLC hardware while using WindLDR.

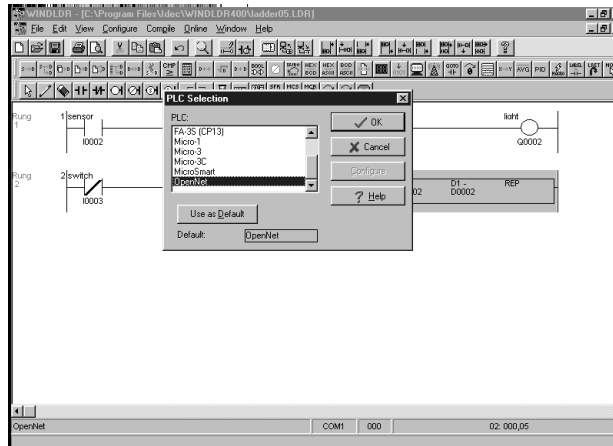
The following options may be selected:



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Configure → PLC Selection

Selecting the PLC Selection... option from the Configure menu allows you to select a PLC for which your current ladder file is to be programmed.



Click the appropriate PLC to select it. Pressing the **Use as Default** button sets the highlighted PLC as the format for new ladder files and for the PLC at start-up.

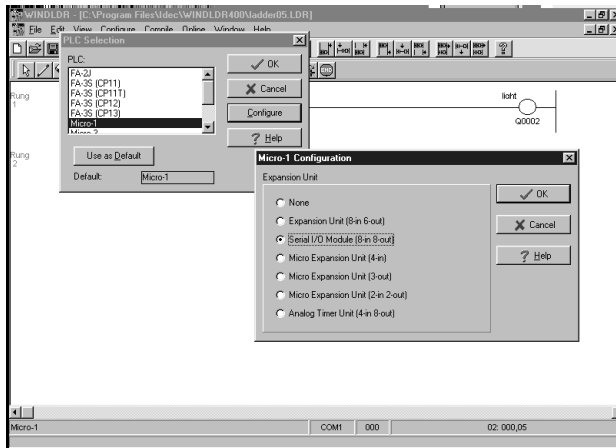
To configure the selected PLC, press the **Configure** button.

Once the appropriate PLC has been selected and configured, click the **OK** button. To back out of this option without any changes, click the **Cancel** button. To access on-line help, press the **Help** button.

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Micro-1 Configuration

If the Micro-1 is highlighted when the **C**onfigure button is pressed, the following dialog box displays.



Expansion

Click the diamond next to the appropriate expansion unit. This field sets the hardware properties (number of inputs and outputs) for the expansion PLC.

Refer to your PLC's hardware manual for complete expansion information.

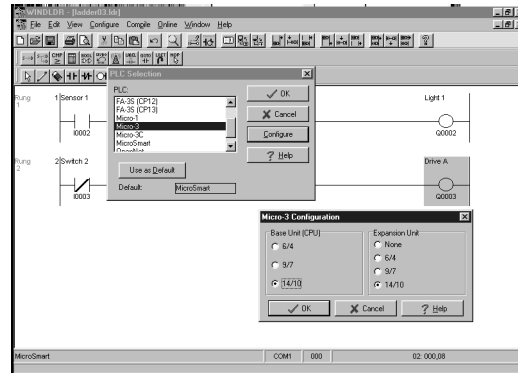
Upon accessing the **Micro-1 Configuration** dialog box, the **Serial I/O Module (8-in, 8-out)** option defaults. Accepting this selection provides the maximum number of available I/O. However, the appropriate expansion unit should be selected.

NOTE: Unlike CLIP, WindLDR checks the I/O for the specific PLC hardware configuration.

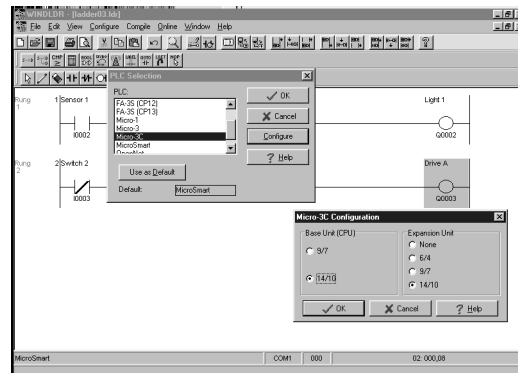


Micro³ Configuration and Micro³C Configuration

If the Micro³ is highlighted when the Configure button is pressed, the following dialog box displays.



If the Micro³C is highlighted when the Configure button is pressed, the following dialog box displays.



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Base Unit [CPU]

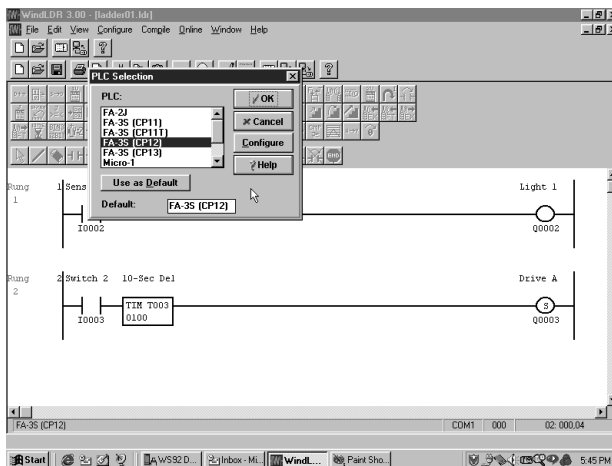
Click the diamond next to the appropriate master PLC hardware properties. The number of inputs is followed by the slash sign and then by the number of outputs.

Expansion Unit

Click the diamond next to the appropriate extension. This field sets the hardware properties (number of inputs and outputs) for the expansion PLC.

FA Series Controller Configuration

If any of the FA series are highlighted when the **Configure** button is pressed, the following dialog box is displayed:

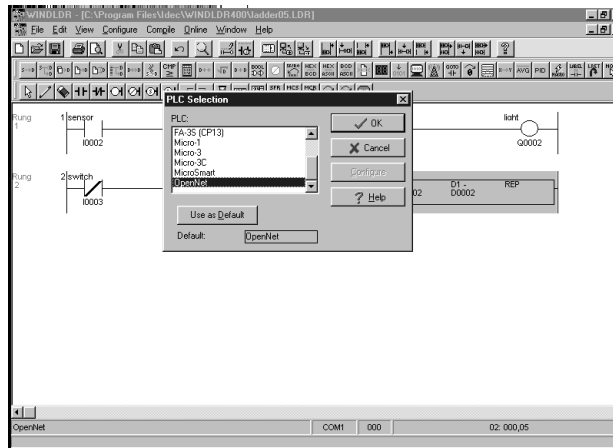


Note: This dialog box is the same for FA1J, FA2J and FA3S (CP11, CP11T, CP12 and CP13).

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Open Net Controller Configuration

If the ONC is highlighted when the **Configure** button is pressed, the following dialog box displays:

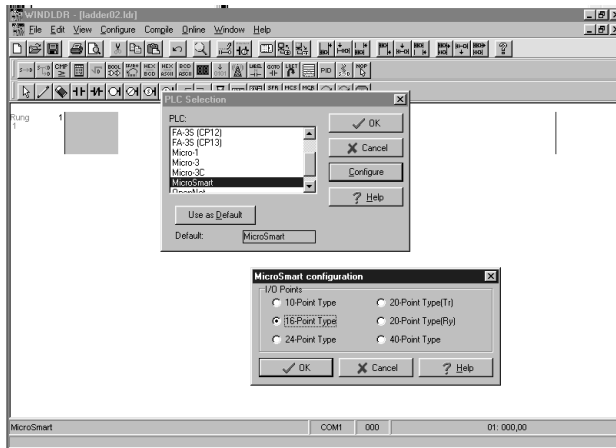


Note: There is no need for additional configuration.

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MicroSmart Controller Configuration

If the MicroSmart is highlighted and the **Configure** button is pressed, the following dialog box is displayed:



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Configure → Function Area Settings...

Selecting the **Function Area Settings...** option from the **Configure** menu allows you to set internal functional settings for the current PLC (as selected in the **PLC selection...** option of the **Configure** menu).



Click the appropriate PLC settings as described in the following field descriptions. Clicking an option selects it. To deselect the option, click another option and click **OK**.

Once the appropriate function area settings have been selected, click the **OK** button. To back out of this option without any changes, click the **Cancel** button. To access on-line help, press the **Help** button.

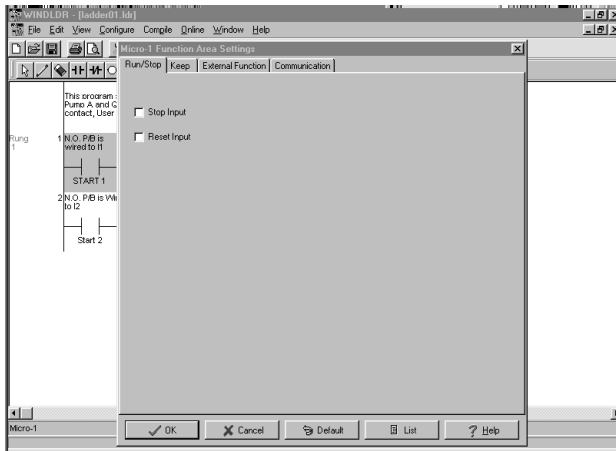
To return to the default settings for the PLC, click the **Default** button at any time.

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Micro-1, FA1J, FA2J, FA3S (CP11/11T, CP12/13) Function Area Settings

Run/Stop setting

This option stops and starts operation of the PLC. When the designated input terminal is turned on, the PLC operation stops. The program operation is then restarted if and when the stop input goes off.



To activate the **Stop Input No. setting**, click the box to the left of **Stop Input** to display a check mark.

Then, in the **Input number** field, enter the desired input number. An enable stop input number can be any input terminal with a value from I0 to I17 for Micro-1, I0 to I317 for FA Series (CP12 and CP13), and I0 to I157 for the rest of the FA Series.

NOTE: Once inputs are entered, they will display in terms of 1000. For example, entering input 2 (I2) will display as I0002.



If the **Default** button is pressed, this and all other corresponding options turn off. In other words, all settings will revert back to the original defaults.

If an invalid stop input number is entered, an error message will display. A valid input number must be entered or the invalid number erased.

Reset input No. setting

This option resets the operation of the PLC when the designated input terminal is activated. The program operation will restart if the input goes off while the start input is on. When the reset input is turned ON, the reset input has priority over the stop input.

To activate the **Reset input No. setting**, click the box to the left of **Enable reset input** to display a check mark.

Then, in the **Input number** field, enter the desired input number. An enable reset input number can have a value from I0 to I17 for Micro-1, I0 to I317 for FA Series (CP12 and CP13), and I0 to I157 for the rest of the FA Series. Input numbers I8 and I9 are not valid.

NOTE: Once inputs are entered, they will display in terms of 1000. For example, entering input 2 (I2) will display as I0002.

WARNING: If the **Default** button is pressed, this and all other corresponding options turn off. In other words, all settings will revert back to the original defaults.

If an invalid reset input number is entered, an error message will display. A valid input number must be entered or the invalid number will be erased.



NOTE: Input numbers ending in 8 or 9 are not valid.

Keep Functions

Three optional status managing functions are available within this field.



Internal Relay Keep

The status of internal relays are cleared in the event of a power failure. It is possible, however, to designate some or all internal relays to retain their status when the program is restarted.

Use this field to designate certain internal relays to keep their status while others are cleared when there is a power failure.

The **All Clear** option (also the default setting) clears the status of all internal relays (upon power up) when there has been a power failure. Click the circle to the left of the option to select it.

The **All Keep** option designates all the internal relays in use to keep their status when there is a power failure. Thus, upon power up, the status of internal relays will remain the same. Click the circle to the left of the option to select it.

The **Keep to** option retains the status of all internal relays (upon power up) prior to the relay entered in the accompanying field. Click the circle to the left of the option to select it. Then enter the appropriate internal relay number in the field to the right. For example, if M100 is entered, then internal relays M0–M100 will retain their current states upon power up. Internal relays M101 and up will be reset.

Counter Keep

Counter values are cleared in the event of a power failure. It is possible, however, to designate some counters to retain their current count when the program is restarted.

Use this field to designate a range of incremental counters which will keep the current count, while others are cleared when the program is restarted.

The **All Clear** option (also the default setting) clears the current count of all the counters (upon power up) when there has been a power failure. Click the circle to the left of the option to select it.

The **All Keep** option designates all counters in use to keep their counts when there is a power failure. Thus, upon power up, the count values of counters will remain the same. Click the circle to the left of the option to select it.

The **Keep to** option retains the counted values (upon power up) of all counters prior to the counter entered in the accompanying field. Click the circle to the left of the option to select it. Then, enter the appropri-



ate counter number in the field to the right. For example, if C9 is entered, then counters C0–C9 will retain their current states upon power up. Counters C10 and up will be reset.

SFR Keep

Shift register bits are cleared in the event of a power failure. It is possible, however, to designate a range of shift register bits to retain their types when the program is restarted.

Use this field to designate a range of shift register bits which will keep their current status, while others are cleared when the program is restarted.

The **All Clear** option (also the default setting) clears all of the current shift register bits (upon power up) when there has been a power failure. Click the circle to the left of the option to select it.

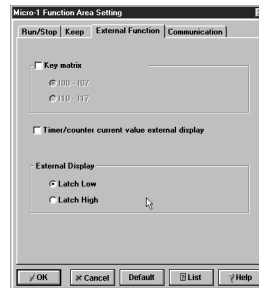
The **All Keep** option designates all shift registers in use to keep their status when there is a power failure. Thus, upon power up, the shift register bits will retain their states (either 0 or 1). Click the circle to the left of the option to select it.

The **Keep to** option retains the shift register bits (upon power up) of all registers prior to the number entered in the accompanying field. Click the circle to the left of the option to select it. Then enter the appropriate register bit number in the field to the right. For example, if R100 is entered, then shift registers R0–R100 will retain their current states upon power up. Shift registers R101 and up will be reset.



External Functions

Activating this option displays the current timer values or the counted counter values as specified. The values of the timer or counter must be designated before transferring the program to the PLC.



To activate this option, click the box to the left of **Enable external display** to show a check mark. The **Timer/counter number:** field will display. Refer to the specific PLC *Hardware Manual* for more information.

If the **Default** button is pressed, this option turns off.

If an invalid timer or counter number is entered, then an error message displays. A valid number must be entered or the invalid number erased.

Key matrix setting (Micro-1 only)

Use this option to set the key matrix which consists of 64 points. These points are configured using 8-in and 28-out.

To activate this option, click the box to the left of **Enable key matrix scan** to show a check mark. The **Input number:** field will display. Refer to the *Micro-1 Hardware Manual* for more information.

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Then, in the **Input number:** field, select the desired range: either **I00 - I07** or **I10 - I17**.

If the **Default** button is pressed, this option turns off.

External Display Latch condition setting

Use this option to set the latch condition for the PLC when using the external display function.

To activate this option, click the circle to the left of either the **Low latch** or **High latch** option accordingly.

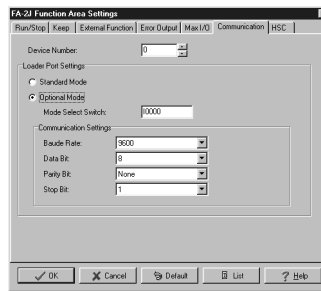
If the **Default** button is pressed, this option will be turned off entirely.

Communication Device Number

Use the communication device registration number to allocate a device number (1 to 255) to each of the PLCs connected in a 1:N communication computer link system.



Micro-1



FA Series



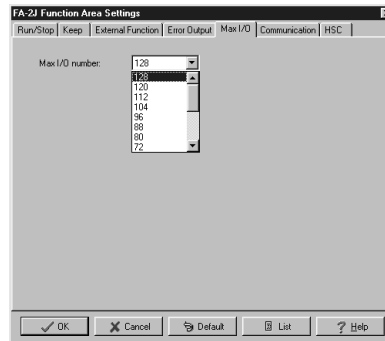
Loader Port Settings

There are 2 selections: **Standard Mode** and **Optional Mode**. The **Optional Mode** allows you to select the desired communication settings and to switch to the setting automatically with a designated input.

NOTE: The List icon displays the PLC functions and details in a notepad file format.

Maximum I/O (FA Series only)

The **Maximum I/O** selection allows the user to determine the maximum number of inputs and outputs which the CPU will be mapping.

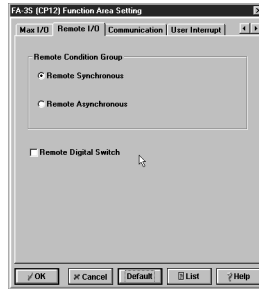


You can choose from 72 to 128 inputs and outputs.



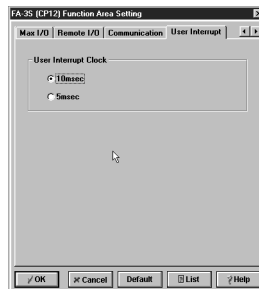
Remote I/O (CP 12 and CP13 only)

The Remote I/O option allows you to select the remote condition group **Synchronous** vs. **Asynchronous** and to select the remote digital switch number.



User Interrupt (CP 12 and CP13 only)

The User Interrupt allows for a 10msec or 5msec clock interruption.

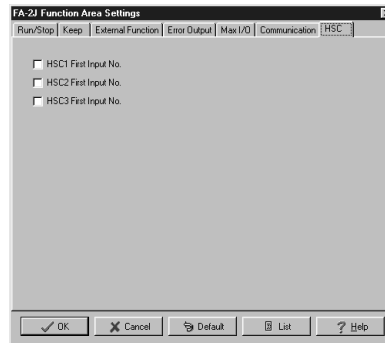


NOTE: The default is 10msec.

The logo for IDEC Corporation, consisting of the lowercase letters "idec" in a bold, sans-serif font.

HSC (FA1J and FA2J only)

The **High Speed Counter** dialog box allows you to choose the HSC type (HSC1, HSC2, or HSC3) and to assign the first input address (I10, I20, or I30 respectively).



Micro³, Micro³C, and ONC Function Area Settings



Click the appropriate PLC settings as described in the following field descriptions. Clicking an option selects it. To deselect the option, click again to delete the mark.

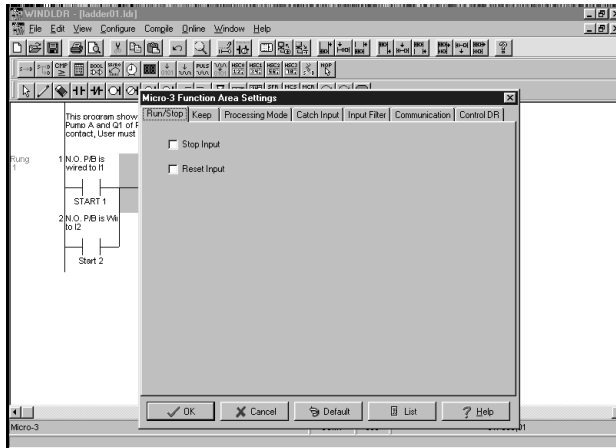
Once the appropriate ladder preferences have been selected, click the **OK** button. To back out of this option without changing any preferences, click the **Cancel** button. To access on-line help, press the **Help** button.

To return to the default settings for the PLC, click the **Default** button at any time.

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Run/Stop

This option stops and starts operation of the PLC.



Stop Input

When the **Stop Input** box is checked, a designated input is needed to turn the PLC operation on/off.

To turn the stop input off, remove the check to the left of the **Stop Input** option.

NOTE: Once inputs are entered, they will display in terms of 1000. For example, entering input 2 (I2) will display as I0002.

If the **Default** button is pressed, this option turns off.

If an invalid input stop number is entered, an error message displays. A valid input number must be entered or the invalid number erased.

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Reset Input

This option stops the operation of the Micro³, Micro³C, and ONC and resets the counters and internal relays.

To turn the reset input off, check the box to the left of the **Reset Input** option.

If the **Default** button is pressed, this option turns off.

If an invalid input stop number is entered, an error message will display. A valid input number must be entered or the invalid number erased.

Keep Functions

3 optional status managing functions are available within this field.

Internal Relay Keep

The status of internal relays (M0–M287 for Micro³ and Micro³C; M0–M2557 for the ONC) are cleared in the event of a power failure. It is possible, however, to designate some internal relays to retain their status when the program is restarted.



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The **All Clear** option (also the default setting) clears the status of all internal relays, upon power up, when there has been a power failure. Check the box to the left of this option to select it.

The **All Keep** option designates all the internal relays in use to keep their status when there is a power failure. Thus, upon power up, the status of internal relays (M0–M287 for Micro³ and Micro³C; M0-M2557 for the ONC) will remain the same. Click the circle to the left of this option to select it.

The **Set** option retains the status of all internal relays (upon power up) prior to the relay entered in the accompanying field. Click the circle to the left of this option to select it. Then enter the appropriate internal relay number in the field to the right. Enter the range to set the boundary of internal relays which will retain their current states upon power up.

NOTE: Input numbers ending in 8 or 9 are not valid.

SFR Keep

Shift register bits (R0–R63 for Micro³ and Micro³C; R0-R254 for the ONC) are cleared in the event of a power failure. It is possible, however, to designate a range of shift register bits to retain their types when the program is restarted.

The **All Clear** option (also the default setting) clears all of the current shift register bits, upon power up, when there has been a power failure. Click the diamond to the left of this option to select it.

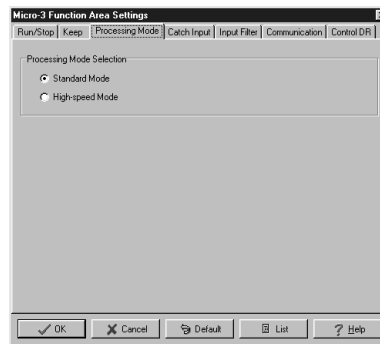


The **All Keep** option designates all shift registers in use to keep their status when there is a power failure. Thus, upon power up, the shift register bits will retain their states (either 0 or 1). Click the diamond to the left of this option to select it.

The **Set** option retains the shift register bits (upon power up) of all registers prior to the number entered in the accompanying field. Click the diamond to the left of this option to select it. Then enter the appropriate register number in the field to the right. Enter the range to set the boundary of shift register bits which will retain their current states upon power up.

Processing Mode (Micro³ and Micro³C only)

Choose between two modes of processing, **Normal** and **Speed**.



The **Normal** processing mode (also the default) has an average processing time of 2.2 μ sec with a minimum processing time of 1.2 μ sec. The average scan time is 2.9 μ sec per 1K step.



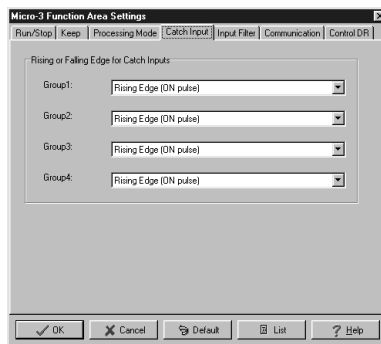
Use the **Speed** (or high-speed) processing mode as a sensor controller or when executing a user program at high speed is necessary. The average processing time is 0.45 μ sec with a minimum processing time of 0.2 μ sec. The average scan time is 400 μ sec per 100 steps.

NOTE: In high-speed mode, control data registers D90–D99 cannot be used.

NOTE: When high-speed mode is selected for the Micro³ series, the I/O expansion link and data link functions cannot be used.

Catch Input (Micro³ and Micro³C only)

Used for short input signals, this option causes the program to catch an input transition before the end of a program scan.



Select the **Up** option, ON pulse/rising, (also the default) when an input switches from OFF to ON. Select the **Dn** option, OFF pulse/falling edge, when an input changes from ON to OFF.

NOTE: For the ONC, please refer to the **ONC Function Area Settings** section of this chapter. You can also refer to the ONC Hardware Manual.

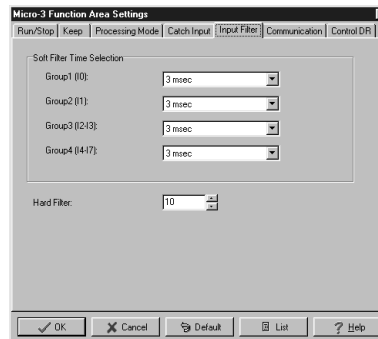


Catch inputs are divided into four groups.

Catch Group	Input Number
G1	I0
G2	I1
G3	I2 and I3
G4	I4–I7 (16- and 24-I/O Micro ³ and Micro ³ C base units) I4 and I5 (10-I/O Micro ³ base units)

Input Filter

The **Input Filter Time Selection** option causes the program to read input transactions after the defined wait time. For example, accepting the default setting of 3 msec, causes the PLC to read an ON setting for an input only if it remains on for more than 3 msec.



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Soft Filter:

The soft filter, divided into four groups, refers to the software-dependent time filters. This allows you some flexibility to define different input wait times for different inputs. Select among four wait time spans for each group: 0, 3, 7, or 10 msec.

Soft Group	Input Number
G1	I0
G2	I1
G3	I2 and I3
G4	I4 through I7

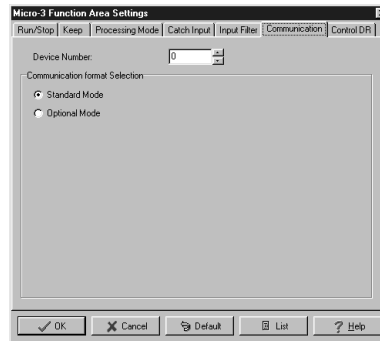
Hard Filter:

The hard filter refers to the hardware-dependent time filters. This allows you to choose a separate time delay for the PLC hardware. Using the up and down arrow scroll bars, select a time delay from 0 to 255 msec. The default setting is 10 msec.



Communication

Use the **Communication Device Number** field to allocate a device number (1 to 31) to each of the Micro³ or Micro³C PLCs connected in a 1:N communication computer link system.



NOTE: This option is only applicable when there is more than one PLC connected to your PC.

Click the up and down arrow scroll bars to select the desired device number.

If the **Default** button is pressed, this option resets to 0.

Communication Format Selection

Select between the default communications mode settings and optional settings. The communication mode settings determine how the PLC and PC will communicate with each other.

NOTE: Check your PLC's hardware manual to determine the appropriate communication mode settings to use.



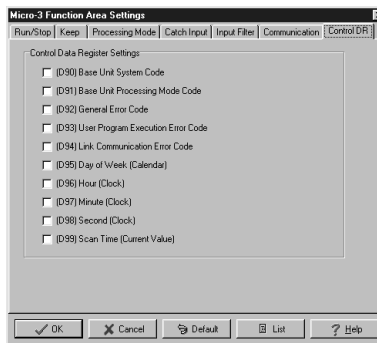
To accept the default settings (according to the following table), leave the diamond to the left of the **Standard Mode** option clicked. To set up your own communication mode settings, click the diamond to the left of the **Optional Mode** option.

	Standard Mode (default)	Optional
Baud Rate	9600 bps	1200 bps, 2400 bps, 4800 bps, 9600 bps, 19200 bps
Data Bits	7	7, 8
Stop Bits	1	1, 2
Parity	Even	None, Odd, Even
Terminator Code	CR (carriage return)	CR (carriage return), CR/LF (carriage return/line feed)
Receive Time-Out:	50 msec	Select within the range of 10 msec to 255 msec
Input number:	N/A	Defined by the type of inputs on the PLC being used



Control Data Register

This option contains information related to the operation status of the PLC.



Select which of the control data registers are essential for operation by clicking the square to the left of each desired option.

If the **Default** button is pressed, no register settings are selected.

The control data registers are divided into ten groups. The following table explains the functionality of each.

Function	Data Register	Data in Control Data Register
Base Unit System Code	D90	Micro ³ /Micro ³ C base unit system code: Bit 1: 24 I/O Bit 2: 16 I/O Bit 4: 10 I/O Bit 8: AC input type Bit 16: Protect source output type

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Base Unit Processing Mode Code	D91	Micro ³ /Micro ³ C base unit processing mode code: 0: Standard processing mode 1: High-speed processing mode
General Error Code	D92	Refer to your PLC's hardware manual for complete information.
User Program Execution Error Code	D93	Refer to your PLC's hardware manual for complete information.
Link Communication Error Code	D94	Refer to your PLC's hardware manual for complete information.
Day of Week	D95	0: Sunday 1: Monday 2: Tuesday 3: Wednesday 4: Thursday 5: Friday 6: Saturday
Hour (Clock)	D96	0 to 23
Minute (Clock)	D97	0 to 59
Second (Clock)	D98	0 to 59
Scan Time (Current Value)	D99	Current scan time in msec



To ensure that the control data registers are correct, complete the following steps.



1. Click on the **Control Data Register Settings** option which you want to check. Click the OK button to accept the screen settings of the **Micro³(C) Function Area Settings** dialog box.
2. Select the **Convert ladder** option from the **Compile** menu to compile your program.
3. Select the **Download program...** option from the **Online** menu to download your program to your PLC.
4. Turn on the monitoring screen.
5. From the **Online** menu, select the **Monitor** option. Enter the control data register setting number selected initially. The data in the control data register should display as described in your PLC's hardware manual.

The following table provides an example of the Base Unit System Code (D90) for various Micro³ PLCs.

Micro ³ PLC Type	Value of D90 (Decimal)	Value of D90 (HEX)
24 I/O type (FC2A-C24B1)	1	1
16 I/O type (FC2A-C16B1)	2	2
10 I/O type (FC2A-C10A1)	4	4
AC input type	8	8

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Protect source output type	10	A
24 I/O type and AC input type	9	9
24 I/O type and protect source	17	11
16 I/O type and AC input type	10	A
16 I/O type and protect source	18	12
10 I/O type and AC input type	12	C
10 I/O type and protect source	20	14

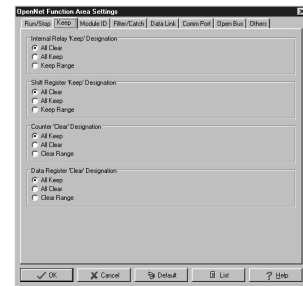


ONC Function Area Settings

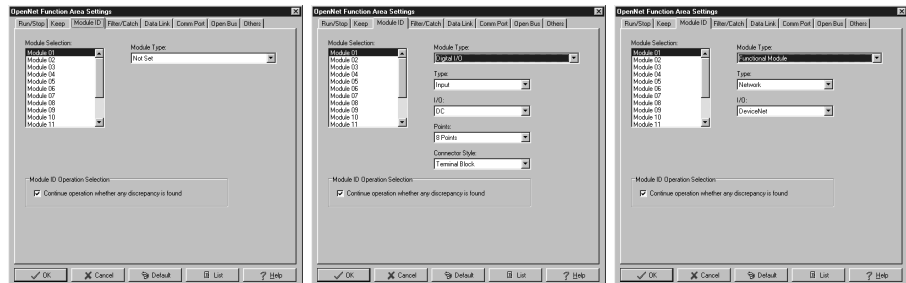
Please refer to the instructions and information in the previous section (**Micro³** and **Micro³C** Function Area Settings). Some instructions for the ONC are the same as those for the **Micro³** and **Micro³C**. You can also find details on the **Function Area Settings** of the ONC in the ONC Hardware Manual. The dialog boxes for the **ONC Function Area Settings** are shown below.



Run/Stop

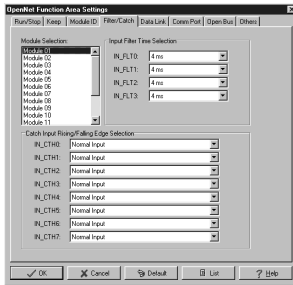


Keep

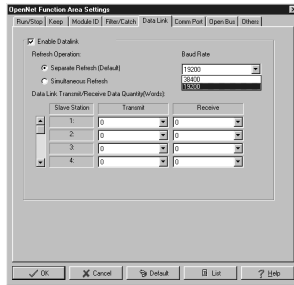


Module I/O

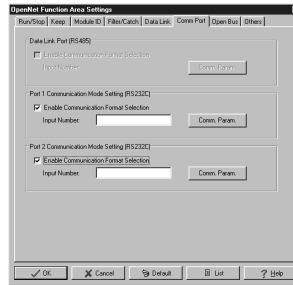
idec



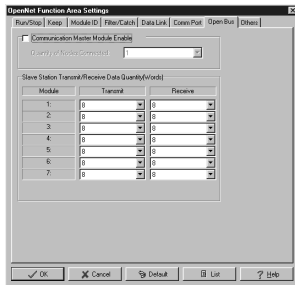
Filter/Catch



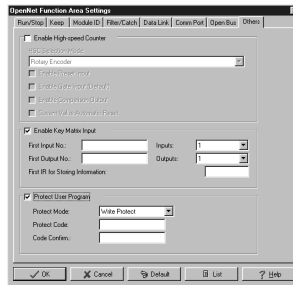
Data Link



Communication Port



Open Bus



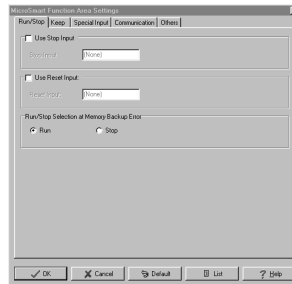
Others

NOTE: For details on all the above selections, please refer to the ONC Hardware Manual.

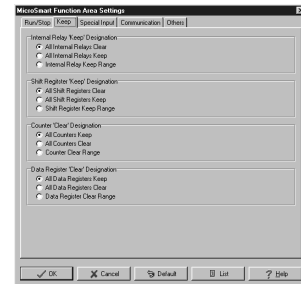


MicroSmart Function Area Settings

Please refer to the instructions and information in the previous section (Micro³ and Micro³C Function Area Settings). Some instructions for the MicroSmart are the same as those for the Micro³, Micro³C and ONC. For further details on the **Function Area Settings** of the MicroSmart please refer to the MicroSmart Hardware Manual. The dialog boxes for the MicroSmart **Function Area Settings** are shown below.



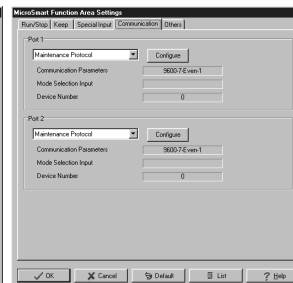
Run/Stop



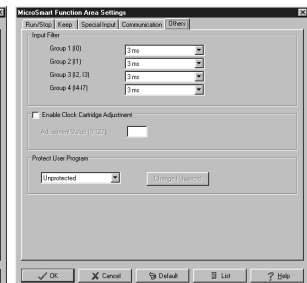
Keep



Special Input



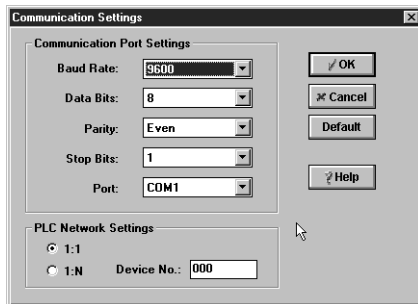
Communication



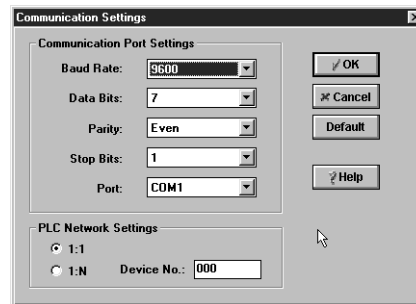
Others

Configure → Communication Settings...

Selecting the **Communication settings...** option from the **Configure** menu allows you to set up the communication mode settings. These settings determine how the PLC and PC will communicate with each other.



Micro-1 and FA Series



**Micro³, Micro³C, ONC and
MicroSmart**



Select the appropriate communication settings. Pressing the **Defaults** button resets the format for the PLC selected in the **Configure → PLC selection** option.

Once the appropriate communication settings have been selected, click the **OK** button. To back out of this option without changing any preferences, click the **Cancel** button. To access on-line help, press the **Help** button.

NOTE: Check your PLC's hardware manual to determine the appropriate communication mode settings to use. Your PC may also have different port configurations.

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Communication Port Settings

Use this option to set up the basic communication options.

	Default	Selected Options
Baud Rate:	9600 (bps)	1200, 2400, 4800, 9600, 19200 (bps)
Data Length:	8 (Micro-1, FA Series) 7 (ONC, Micro ³ , Micro ³ C, MicroSmart)	7, 8
Parity:	EVEN	EVEN, ODD, NONE
Stop Bits:	1	1, 2
Port:	COM1	COM1, COM2, COM3, COM4

Use the up and down arrow scroll bars to select the appropriate settings.

PLC Network Settings

If only one PLC is connected to your PC, click the circle to the left of the 1:1 option.

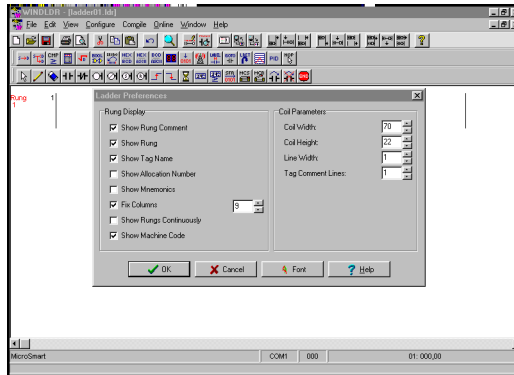
If a PLC network is connected to your PC, click the circle to the left of the 1:N option. Then use the **Device No.:** field to allocate a device number to the current PLC selected in the **Configure → PLC selection** option. For Micro-1, FA Series PLCs and MicroSmart, enter 0–31. For Micro³, Micro³C, and ONC PLCs, enter 0–255.



Repeat this procedure for each PLC connected to your PC.

Configure → Ladder preferences...

Selecting the Ladder preferences... option from the **Configure** menu displays the Ladder Preferences dialog box.



Rung Display

To specify the options which will display on the rungs of the ladder, click the square next to each appropriate selection.

<p>Show Rung Comment</p>	<p>Clicking this option displays a comment that is associated with a rung and appears before the rung. Every rung has a rung comment of at least one line but does not have a fixed length.</p>
<p>Show Rung</p>	<p>Clicking this option displays the rung, tag name, and allocation numbers.</p> <p>To turn off the rung display, leave the square unchecked. This option is useful when you are only interested in mnemonics.</p>

Show Tag Name	Clicking this option displays the tag name under each coil. Normally, only the tag name is displayed.
Show Allocation Number	Clicking this option displays the allocation number under each coil.
Show Mnemonics	Clicking this option displays the ladder mnemonics under each coil after compiling.
Fix Columns	Clicking this option and setting the number of fix columns will set the rungs to the number of columns specified.
Show Rungs Continuously	Clicking this option displays left and right power rails continuously.
Show Machine Code	Clicking the Show Mnemonics and this option displays the machine code under each coil after compiling.

Coil Parameters

To specify the parameters of each coil on the rung, enter an appropriate figure in each field. You may click the up and down arrows to select the figures as well.

Coil Width	Enter the width of each coil in pixels.
Coil Height	Enter the height of each coil in pixels.
Line Width	Enter the width of each line in pixels.
Tag Comment Lines	Enter the number of tag comment lines to be allowed with each tag name. This number can be up to 100 lines, <i>however it is recommended that you restrict the tag comment lines to 4 lines</i> . This number is fixed until the number is changed again within this field.

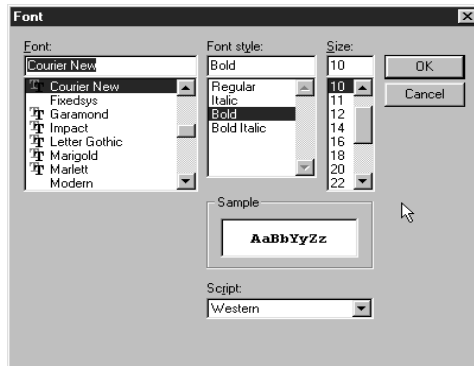




Once the appropriate ladder preferences have been selected, click the **OK** button.

To back out of this option without changing any preferences, click the **Cancel** button. To access on-line help, press the **Help** button.

The **Ladder Preferences** dialog box also gives you the option to change the screen fonts by clicking the **Font** button. This displays the **Font** dialog box.



Within the **Font** dialog box, select the font type, style, and size. A visual example of the selected font will display in the **Sample** field.

Once the appropriate font has been selected, click the **OK** button. To back out of this option without changing the font, click the **Cancel** button.

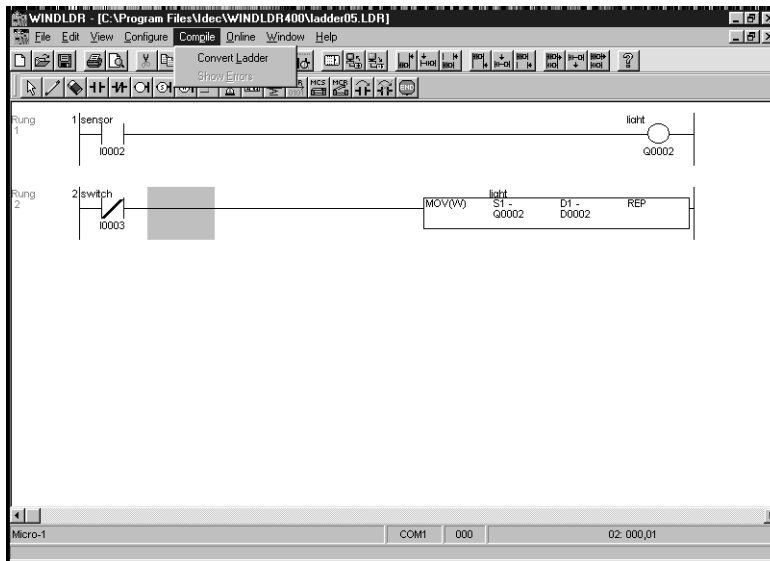
NOTE: The availability of fonts within the **Font** dialog box is dependent upon the fixed width fonts that are installed in Windows.



7. COMPILE MENU

The fifth menu option available is the **Compile** menu which allows you to convert ladder files and to gather any errors created during the ladder conversion.

The following options may be selected:



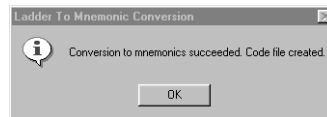
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Compile → Convert Ladder

Selecting the **Convert Ladder** option from the **Compile** menu allows you to convert the entire current ladder to mnemonics. Simply selecting the option is the only step necessary to use this feature.

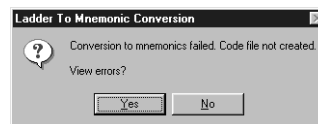
When a ladder file completes its attempt at conversion, the **Ladder to Mnemonic Conversion** dialog box displays.

When a ladder file successfully converts, the message, “Conversion to mnemonics succeeded. Code file created,” displays.



Click the **OK** button to acknowledge your successful conversion.

When a ladder conversion is unsuccessful, the message, “Conversion to mnemonics failed. Code file not created. View errors?”



To view the errors which prevented a successful conversion, click the **Yes** button. The **Error Message Dialog** box displays.

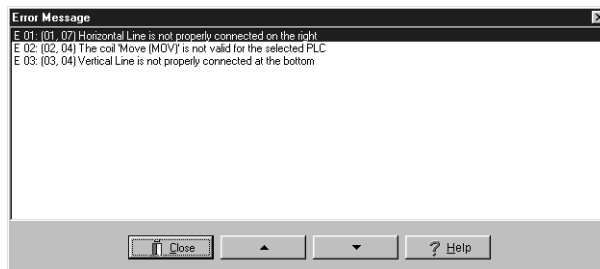
To ignore the **Error Message Dialog** screen, click the **No** button.

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Compile → Show Errors

Selecting the **Show Errors** option from the **Compile** menu displays a log of any and all errors created through the **Convert Ladder** option. This menu is only active when errors have occurred in the ladder to mnemonic conversion.

You may also access this screen by clicking the **OK** button from the **Ladder to Mnemonic Conversion** dialog box.



Using the **Up** and **Down** buttons, you may scroll through the errors in the ladder file.

Once you have used the **Up** and **Down** buttons to highlight an error, you may click the **OK** button. The **Error Message Dialog** screen disappears, and the selected erroneous rung is highlighted for correction.

TROUBLESHOOTING TIPS: Click the error message in question to highlight it. Then, press the **Help** button to access on-line help for specific assistance in troubleshooting the error.

To exit out of this dialog box without selecting an error to pinpoint, click the **Cancel** button.



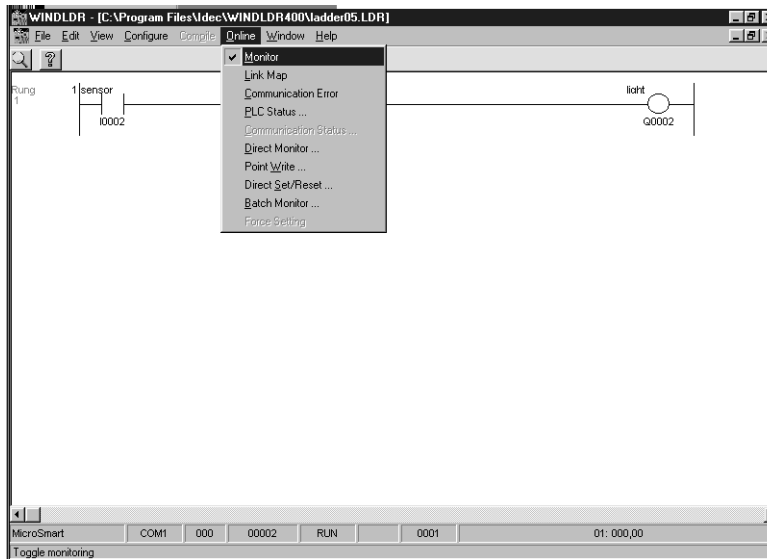
NOTE: You also may edit the ladder without closing the **Error Message Dialog** screen. However, adding or deleting rungs this way will alter the locations of the following error messages.



8. ONLINE MENU

The sixth menu option available is the **Online** menu. This option allows you to monitor the status of your PLC conveniently from your PC, to upload and download your ladder programs to and from your PLC, to check for any communication errors which may have occurred during the connection, and to set up the link map in the PLC network.

The following options may be selected:



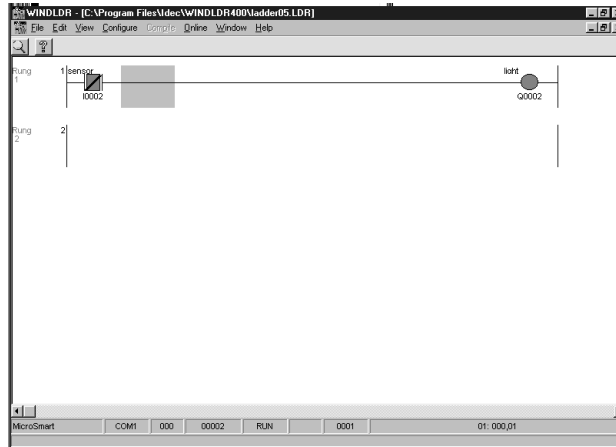
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The options below are available from the **Monitor** option of the **Online** menu:

- Monitor (Ladder Monitor)
- Link Map
- Communications Errors
- PLC Status
- Direct Monitor
- Point Write
- Direct Set/Reset
- Batch Monitor

Online → Monitor

Selecting the **Monitor** option from the **Online** menu allows you to monitor the activity of the current PLC. Once this option is selected, the following monitoring screen will display.



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NOTE: If you have more than one file opened while using **Monitor** mode, you can only monitor the file which is running in the PLC.



To return to ladder editing screen, select the **Monitor** option from the **Online** menu again.

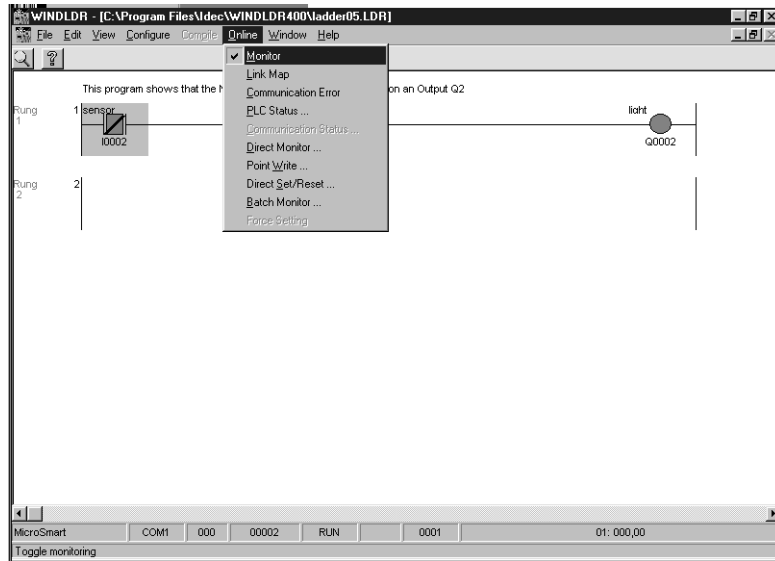
From the **Monitor** display, modified versions of some menu items are available.

Menu	Option	Function
File	<u>E</u> xit WindLDR	Ends the WindLDR program
Edit	<u>F</u> ind...	Searches for tag names, allocation numbers, and tag name comments
View	<u>T</u> ool bar	Toggles the main toolbar at the top of the display on and off
	<u>S</u> tatus bar	Toggles the status bar at the base of the display on and off
	Tip <u>M</u> essages	Toggles the tip messages on and off
	<u>L</u> adder preferences...	Displays the Ladder Preferences dialog box from which to select rung and coil preferences

NOTE: For more detailed information about the preceding menu options, refer to their corresponding chapters.

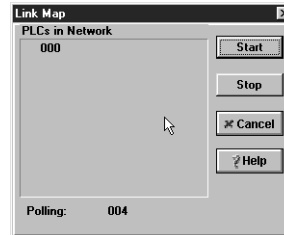


Additionally, new options are available from the **Online** menu.



One → Monitor → One → Link Map

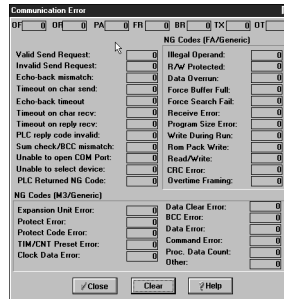
This option displays the PLC network. When the **Start** button is pushed, WindLDR begins to display all the PLC numbers which are networked to the working PLC. This option also allows you to keep track of all the PLC's on the network and all of the data routing.



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One → Monitor → One → Communication Error

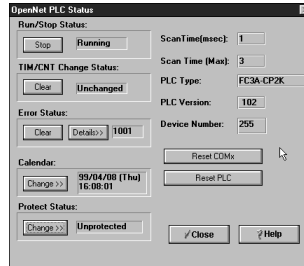
This option displays any errors which may occur during communication, giving you a chance to troubleshoot the system. You can simply clear the errors by clicking the Clear button.



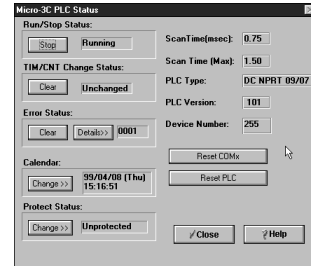
One → Monitor → One → PLC status: *Status Dialog (ONC, Micro³ and Micro³C)*

This option displays PLC information, start and stop status, error status, timer/counter settings, calendar and protect status.

When an ONC PLC is active and the **PLC status** option is selected from the **Online (monitoring)** screen, the **ONC Status Dialog** screen will display.



ONC

Micro³, Micro³C

NOTE: The following instructions and field descriptions are applicable to the ONC, Micro³, and Micro³C PLC's.



To return to the monitor mode, click the **Cancel** button.

To access on-line help, press the **Help** button.

Run/Stop Status:

Use this field to start and stop the operation of your PLC. When the PLC is not in run mode, the **Start** button is available. Additionally, the status of the PLC displays as STOPPED.

When the PLC is in run mode, the **Stop** button is available. The status of the PLC now displays as RUNNING.



The PLC memorizes the Start/Stop status before the power is turned off. When the PLC is restarted, it maintains same status as prior to its shutdown.

Tim/Cnt Change Status:

When the status displays as CHANGED, you may press the **Clear** button. This function serves two purposes:

- To clear the modified counter and counter preset values
- To restore the original timer and counter preset values

Once the **Clear** button has been pressed, the status again displays as UNCHANGED.

Error Status:

Use this option to view all errors which have occurred during operations. The number of the error displays in the accompanying field.

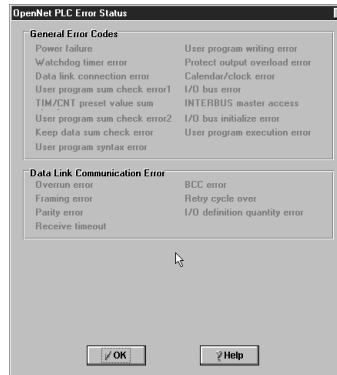
Clear

Click the **Clear** button to erase errors after they have been fixed. If an error has not been fixed, it will not clear.



Details>>

Click the **Details>>** button to view information about the error number which displays in the accompanying field. Clicking the **Details>>** button displays the **Error Code Dialog** screen.



To return to the monitor mode, click the **OK** button.

To access on-line help specific to the highlighted errors, press the **Help** button.

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The following table displays a list of the most common error numbers and descriptions.

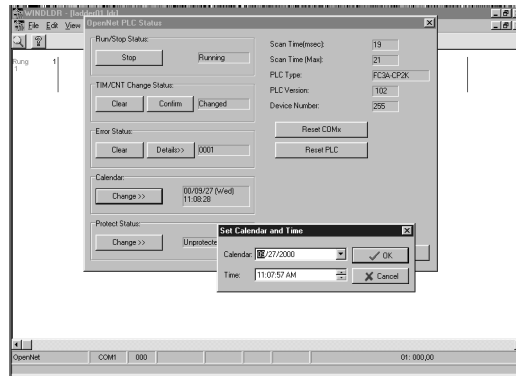
Error Number	Error Description
1	Power failure
2	WDT (watchdog timer error)
3	CRC comparison code keep error
4	User program CRC error
5	Timer/counter preset value CRC error
6	Program sum check error
7	Keep data sum check error
8	User program syntax error
9	System program error
10	User program writing error



Calendar:

The current date (YY/MM/DD), day of the week, and time (based on a 24-hour clock) display.

To update any calendar information, click the **Change>>** button. The **Set Calendar and Time** dialog box will display.



Once all changes have been made, click the **OK** button to record the new date and time within the **PLC Status Dialog** screen.

To return to the **PLC Status Dialog** screen without making any changes, click the **Cancel** button.

Calendar:

The current date (MM/DD/YY) displays in this field. Click on the month, date, or year. Then, enter the new digits to correct each individually.

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NOTE: For January through September, enter a “0” first. For example, enter: 03 to denote March.

Time:

The current time ((H)H/MM/SS AM or PM) displays in this field. Click on the hour, minute, second, or AM/PM. Then, enter the new digits to correct each individually.

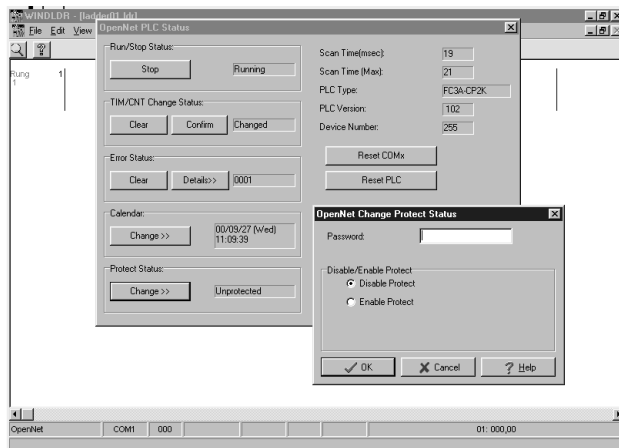
Protect Status:

Use this field to protect your PLC from reading from and/or writing to a ladder program. If a user program is write- or read/write-protected, then it cannot be changed without the password.



To protect a user program, first transfer it from either the program loader or the PC.

If the accompanying field displays UNPROTECTED, then click the **Change>>** button to display the **Protect Status** dialog box.



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Complete the following fields. Then, click the **Enable** button to establish protection. Once you return to the **PLC Status Dialog** screen, the **Protect Status:** field will display PROTECTED.

To back out of this option without setting up protection status, click the **Disable** button.

To access on-line help, press the **Help** button.

IMPORTANT:

Password:

Enter a password of one to four digits using the 0–9 and A–F keys. Make sure to note this password. Future changes in protect status cannot be made without it.

Protect type:

Select one of the following two protection modes: Disable Protect or Enable Protect.

Scan Time:

This field displays the current amount of times it takes to complete one loop of the program in milliseconds. The scan time is updated every scan.

Scan Time (Max):

This field displays a record of the longest amount of time (since the PLC started) it has taken to complete one loop of the program in milliseconds. The maximum scan time is updated every scan.



[PLC] Status Dialog Box, continued**PLC Type:**

This field displays the configuration of the attached PLC base unit.

PLC Version:

This field displays the version number of the attached PLC unit.

Device Number:

This field displays the device number assigned to the PLC which is currently communicating with the program.

Reset COMx

Press this button to re-initializes the communications port.

Emergency

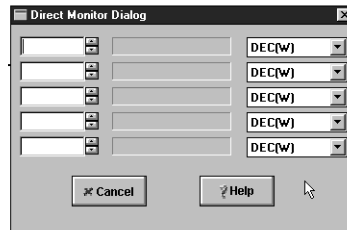
When all else fails, click the **Reset PLC** button in the **Emergency** field to reset the current PLC.



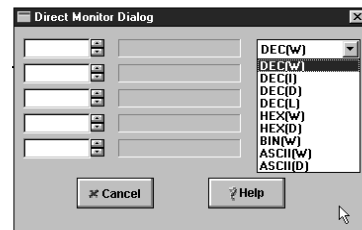
Online → Monitor → Online → Direct monitor

The **Direct Monitor Dialog** screen monitors: inputs, outputs, internal relays, shift registers, preset and current values of timers and counters, and the data of data registers.

NOTE: For the Micro³ series, the control data registers (D90–D99) can be monitored during run mode operations. Use these registers to monitor: base unit system codes, base unit processing mode codes, general error codes, user program execution error codes, days of the week, hours, minutes, seconds, and the scan times.



Direct Monitor Dialog Box



Type of data displayed

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To monitor operand commands, use the following table to enter allocation numbers in the white fields of the **Direct Monitor Dialog** screen.

Press the [TAB] button to navigate between entry fields.

At any time, click the **Cancel** button to return to the monitoring screen. To access on-line help, press the **Help** button.

To Monitor...	Instruction	Example
Inputs	Enter: <u>I</u> plus the allocation number	I0
Outputs	Enter: <u>Q</u> plus the allocation number	Q1
Timers	Enter: <u>T</u> plus the allocation number	T2
Counters	Enter: <u>C</u> plus the allocation number	C3
Shift Registers	Enter: <u>R</u> plus the allocation number	R4
Internal Relays	Enter: <u>M</u> plus the allocation number	M5
Data Registers	Enter: <u>D</u> plus the allocation number	D6
Link Registers (ONC only)	Enter: <u>L</u> plus the allocation number	L100

As operands are entered, the corresponding values of each will display in the gray field to the right.



The method of entering operands follows the syntax of the PLC communications protocols.

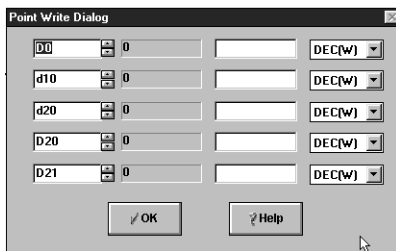
Input Number	Syntax
i0	Monitor input 0 (one bit)
I0	Monitor inputs 0–7 (one byte)
q0	Monitor output 0 (one bit)
Q0	Monitor outputs 0–7 (one byte)
m0	Monitor internal relay 0 (one bit)
M0	Monitor internal relays 0–7 (one byte)
t0	Timer 0 current value (one word)
T0	Timer 0 preset value (one word)
c0	Counter 0 current value (one word)
C0	Counter 0 preset value (one word)
D0	Read data register 0 (one word)



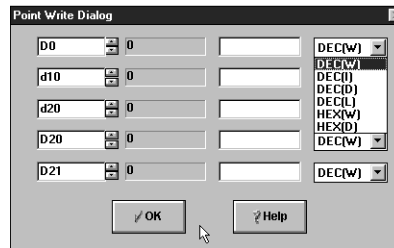
Online → Monitor → Online → Point Write...

The **Point Write Dialog** screen allows you to change the preset values for inputs, outputs, internal relays, and shift and data registers **while** the PLC is running.

The **Point Write Dialog** screen also allows you to change the preset values for timers for counters and for data registers whether or not the PLC is running. This option is particularly useful for entering preset values for high-speed counters when data registers are used. Use the **Word Write** field to make changes to timers, counters, and data registers.



Point Write Dialog Box



Type of data displayed

Word Write



To change the preset values of timers, counters, and data registers, complete the following steps within the **Word Write** field.

Press the [TAB] button to navigate between entry fields.

At any time, click the **OK** button to return to the monitoring screen. To access on-line help, press the **Help** button.

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To Change Preset Values of...	Instruction
Timers	<p>Enter: <u>T</u> plus the allocation number in the left white box of the Word Write field. Press the [TAB] key.</p> <p>The preset value displays in the gray box.</p> <p>Enter the new preset value in the right white box. Press the [ENTER] key.</p> <p>The new preset value display in the gray box.</p>
Counters	<p>Enter: <u>C</u> plus the allocation number in the left white box of the Word Write field. Press the [TAB] key.</p> <p>The preset value displays in the gray box.</p> <p>Enter the new preset value in the right white box. Press the [ENTER] key.</p> <p>The new preset value display in the gray box.</p>
Data Registers	<p>Enter: <u>D</u> plus the allocation number in the left white box of the Word Write field. Press the [TAB] key.</p> <p>The preset value displays in the gray box.</p> <p>Enter the new preset value in the right white box. Press the [ENTER] key.</p> <p>The new preset value display in the gray box.</p>



NOTE: Changes made to the timers and counters can be removed in the [PLC] status dialog box. Access the [PLC] status dialog box from the **Online** menu in the monitoring mode (**Online**→**Monitor**→**Online**→**PLC status**). Then click the **Clear** button in the **Tim/Cnt Change Status:** field. (The displayed status will switch from CHANGED to UNCHANGED.)

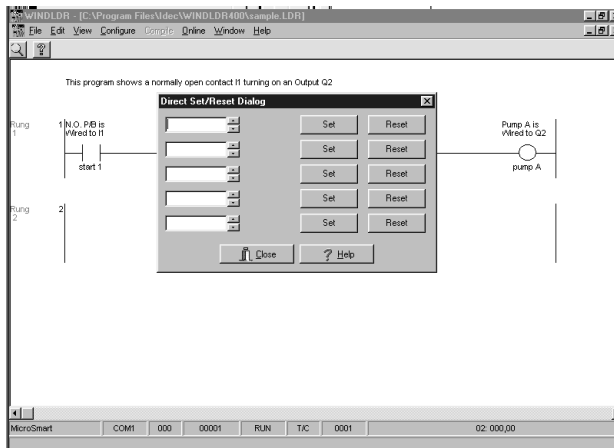
Bit Set/Reset



To set or reset the values of inputs, outputs, internal relays, and shift registers, complete the following steps within the **Bit Set/Reset** field.

Press the [TAB] button to navigate between entry fields.

At any time, click the **OK** button to return to the monitoring screen. To access on-line help, press the **Help** button.



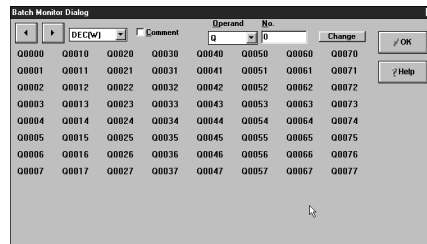
NOTE: These operands can only be changed while the PLC is in run mode. Additionally, the input status will be maintained for the length of one scan only. The status continually updates with the newly read scan information.

To Set or Reset the Values of...	Instruction
Inputs, Outputs, Internal Relays, Shift Registers	<p>Enter the desired allocation number into the white box of the Bit Set/Reset field. Press the [TAB] key.</p> <p>If the operand is OFF, 0 will display in the gray box.</p> <p>If the operand is ON, 1 will display in the gray box.</p> <p>To set this operand, click the Set button.</p> <p>To reset this operand, click the Reset button.</p>

NOTE: You may also right-click with your mouse to set/reset a selected **Internal Relay** or **Output Coil** as long as the selection does not conflict with the program logic.

Online → Monitor → Online → Batch Monitor



This option allows you to monitor an array of inputs, outputs, timers, counters, data registers, and so forth by simply selecting the operand.



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To monitor your programs in batches:

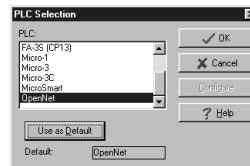
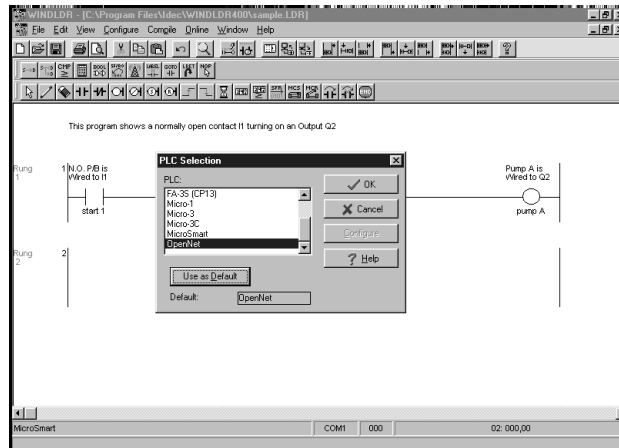
1. Click Online → Monitor from the Menu Commands toolbar.
2. Click Online → Batch Monitor from the Menu Commands toolbar.
3. Type the desired operand and starting address.
4. Scroll forward and backward by clicking the  or  buttons.

One → Upload program...

Selecting the **Upload program...** option from the **Online** menu allows you to upload a file from your PLC and convert it to a ladder file on your PC.

You may also click the toolbar button: 

Then PLC Selection Dialog screen will display.



Click on the desired PLC to select it. Then press the **OK** button.

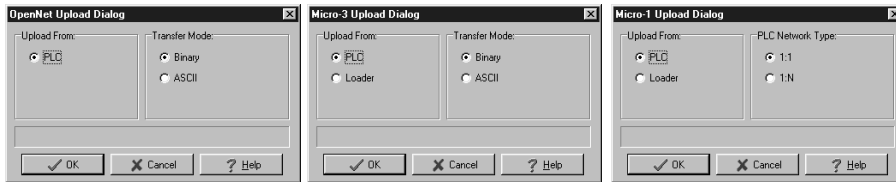
To back out of this option, click the **Cancel** button. To access on-line help, press the **Help** button.

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Upload Dialog

Below is the PLC Selection dialog box.

NOTE: Different screens display depending on the selected PLC.



**ONC &
MicroSmart**

Micro³ and Micro³C

**Micro-1, FA1J/2J, &
FA3S (CP11/11T, CP12/13)**



Click on the desired options. Then press the **OK** button.

As the transfer occurs, it will display the current transfer status.

To back out of this option, click the **Cancel** button. To access on-line help, press the **Help** button.

Upload From:

Click the diamond to the left of the desired option. Select to upload the file from either a PLC or a loader.

Transfer Mode: (MicroSmart, ONC, Micro³, and Micro³C only)

Click the circle to the left of the desired option. Note whether the transfer mode is binary or ASCII.



PLC Network Type:

Click the circle to the left of the desired option. Select 1:1 if only one device is connected to your PC. Select 1:N if a PLC network is connected to your PC.

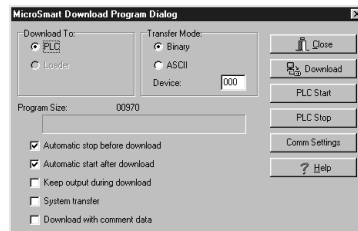
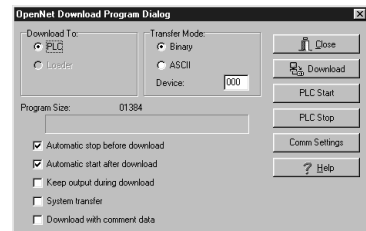
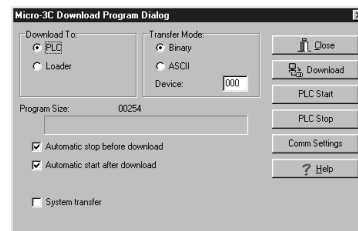
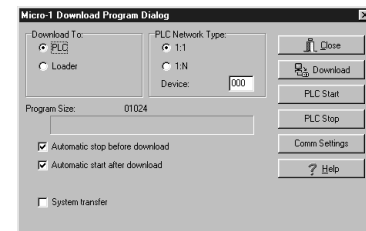
Online → Download program...

Selecting the **Download program...** option from the **Online** menu allows you to download a ladder file from your PC and convert it to a file on your PLC or program loader.

You may also click the toolbar button:

**PLC Download Dialog**

For downloading, click **Online** → **Download**. The following screen will display.

**MicroSmart****ONC****Micro³ & Micro³C****Micro-1 & FA1 Series**



Click on the desired options. Then press the **OK** button.

As the transfer occurs, it will display the current transfer status.

To back out of this option, click the **Cancel** button. To access on-line help, press the **Help** button.

Download To:

Click the diamond to the left of the desired option. Select to download the file to either a PLC or a loader.

PLC Network Type: (Micro-1, FA1J, FA2J, and FA3S series)

Click the diamond to the left of the desired option. Select 1:1 if only one device is connected to your PC. Select 1:N if more than one device is connected to your PC.

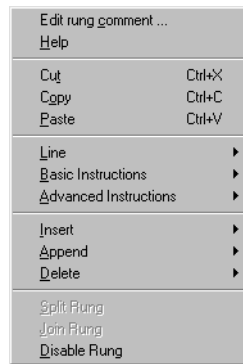
Transfer Mode:

Click the diamond to the left of the desired option. Note whether the transfer mode is binary or ASCII.



9. EDITING THE LADDER

Using your right mouse button, it is possible to perform all the operations necessary to edit your ladder file. To access these instructions, click your right mouse button within the area of your ladder file in which you wish to insert or edit. The initial menu of right mouse button features displays.





Select menu items and sub-menus by moving the mouse to highlight the desired topics and then clicking the mouse to select. Selecting an individual topic will either immediately perform the indicated action or will display the corresponding dialog box. Selecting a sub-menu (denoted by an ► arrow to the right of the item) displays the next menu.

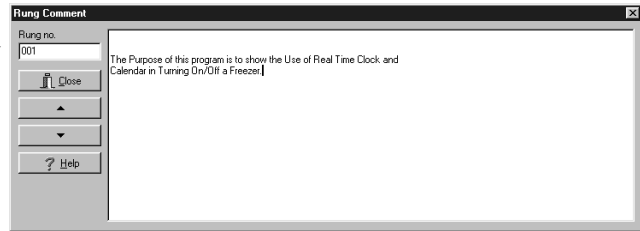
NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, first select the PLC using the **Configure** → **PLC Selection** option.







Right Mouse → Edit rung comment...

Selecting the **Edit rung comment...** instruction with the right mouse button allows you to edit the current rung comment, as well as to edit all rung comments by using the  and  buttons.

The number of the rung comment which is currently being edited displays in this field. Use the up and down arrows to scroll through the available rung comments.



To enter a comment, click within the text area and begin typing. The comment entered is applicable to the number of the rung which displays in the upper left corner.

You may access and edit all rung comments by clicking the  and  buttons. The  button accesses the previous rung comment. The  button accesses the next rung comment. Comments are saved each time a new rung is accessed.

Once all rung comments are entered, click the **Close** button to close the **Rung Comment Dialog** screen.

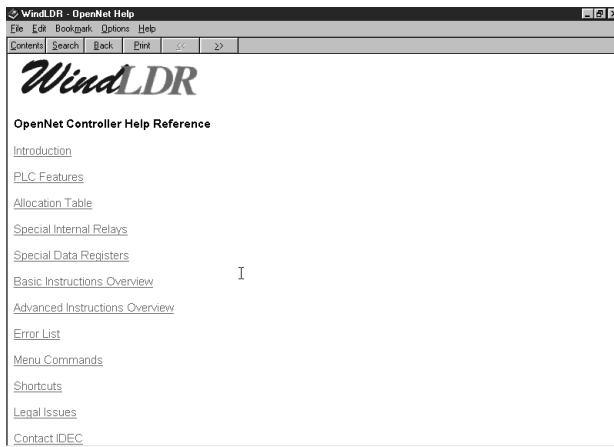
To access on-line help, press the **?** button.

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NOTE: The Micro³ and Micro³C allow up to 44 characters per line within the **Rung Comment** field. The Micro-1 allows up to 48 characters per line.

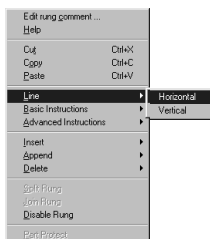
Right Mouse → Help

Selecting the **Help** option with the right mouse button accesses the complete on-line help file. The detailed set of Help screens is like having an entire library of PLC manuals at your fingertips, complete with easy access and context-sensitive help about everything from WindLDR functions to the specified PLC chosen in the **Configure → PLC Selection** option.



Right Mouse → Line

Selecting the **Line** instruction with the right mouse button accesses the **Line** sub-menu.



Selecting **Line→Horizontal** displays a horizontal line across the selected area of the ladder. (The selected area appears as a shaded gray square.) This instruction extends the horizontal part of a rung between switches.

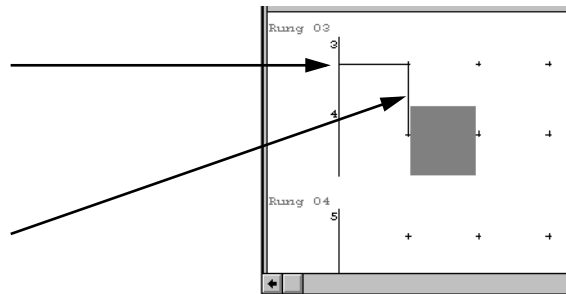
Selecting **Line→Vertical** displays a vertical line running down from the selected area of the ladder. (The selected area appears as a shaded gray square.) This instruction is used to program or to connect conditions on a ladder rung.

To draw lines in WindLDR, you may also use the [SHIFT] + [ARROW] keys.

Or, you may use the  toolbar button.

This horizontal line displays when you select the **Line→Horizontal** instruction with the right mouse button.

This vertical line displays when you select the **Line→Vertical** instruction with the right mouse button.

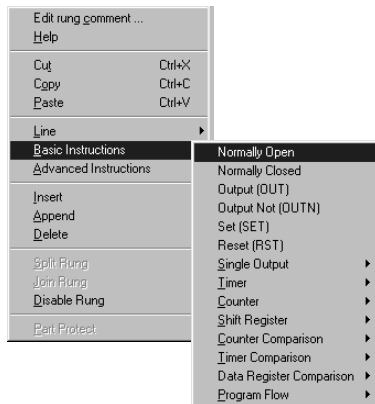


Right Mouse → Basic Instructions

Selecting **Basic Instructions** with the right mouse button accesses the Basic Instructions sub-menu.

NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure → PLC Selection** option.





Symbol	Name	Function	Address Req'd
AND	And	Series connection of normally open (NO) contact	1
AND LOD	And Load	Series connection of circuit blocks	1
ANDN	And Not	Series connection of normally closed (NC) contact	1
BPP	Bit Pop	Restores the result of bit logical operation which was saved temporarily	1
BPS	Bit Push	Saves the result of bit logical operation temporarily	1
BRD	Bit Read	Reads the result of bit logical operation which was saved temporarily	1

CC=	Counter Comparison (=)	Equal to comparison of counter current value	2
CC>=	Counter Comparison (>=)	Greater than or equal to comparison of counter current value	2
CNT	Counter	Adding or reversible counter (0 to 9999)	2
END	End	Ends a program	1
JEND	Jump End	Ends a jump instruction	1
JMP	Jump	Jumps a designated program area	1
LOD	Load	Stores intermediate results and reads contact status	1
LODN	Load Not	Stores intermediate results and reads inverted contact status	1
MCS	Master Control Set	Starts a master control	1
MCR	Master Control Reset	Ends a master control	1
NOT	Not	Inversion	—
OR	Or	Parallel connection of NO contacts	1
OR LOD	Or Load	Parallel connection of circuit blocks	1




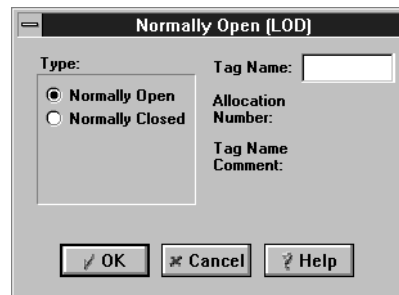
ORN	Or Not	Parallel connection of NC contacts	1
OUT	Output	Outputs the result of bit logical operation	1
OUTN	Output Not	Outputs the inverted result of bit logical operation	1
RST	Reset	Resets output, internal relay, or shift register bit	1
SET	Set	Sets output, internal relay, or shift register bit	1
SFR	Shift Register	Forward shift register	2
SFRN	Shift Register Not	Reverse shift register	2
SOTD	Single Output Down	Falling-edge differentiation output	1
SOTU	Single Output Up	Rising-edge differentiation output	1
TIM	Timer	Subtracting 100 msec timer (0.1 to 999.9 sec)	2
TMH	Timer	Subtracting 10 msec timer (0.01 to 99.99 sec)	2
TMS	Timer	Subtracting 1 msec timer (0.001 to 9.999 sec)	2



Right Mouse → Basic Instructions → Normally Open

Selecting **Basic Instructions → Normally Open** displays the **Normally Open (LOD)** dialog box.

You may also click the toolbar button: 



NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure → PLC Selection** option.

Use the Load (LOD) instruction before an operand starting at the left bus of the ladder diagram. The LOD instruction starts the logical operation with a normally open (NO) contact.

The following chart provides all normally open (LOD) operands.

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Instruction	Standard	High-Speed
I	000–035	000–015
Q	000–031	000–011
M	000–317	000–047 290–297 300–317
T	000–031	000–015
C	000–031	000–015
R	000–063	000–031



Accept the default, **Normally Open**, in the **Type:** field.

Then, enter the tag name (or *nickname*) in the **Tag Name:** field.

Next, enter the appropriate operand in the **Allocation Number:** field.

Finally, optionally enter any associated comment in the **Tag Name Comment:** field. This reference may be a maximum of six characters per line for a maximum of four lines.

Once the dialog box is complete, click the **OK** button to display the normally open instruction on your ladder. To back out of this instruction without utilizing the normally open instruction, click the **Cancel** button.

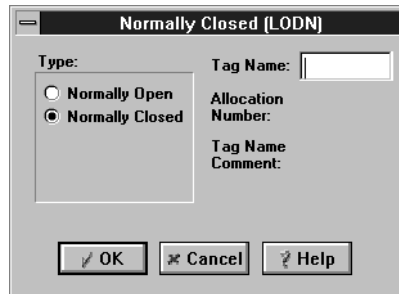
To access on-line help, click the **Help** button.



Right Mouse → Basic Instructions → Normally Closed

Selecting **Basic Instructions → Normally Closed** displays the **Normally Closed (LODN)** dialog box.

You may also click the toolbar button:



NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure → PLC Selection** option.

Use the Load Not (LODN) instruction before an operand starting at the left bus of the ladder diagram. The LODN instruction starts the logical operation with a normally closed (NC) contact.

The following chart provides all normally closed (LODN) operands.

Instruction	Standard	High-Speed
I	000–035	000–015
Q	000–031	000–011
M	000–317	000–047 290–297 300–317
T	000–031	000–015
C	000–031	000–015
R	000–063	000–031



Accept the default, **Normally Closed**, in the **Type:** field. Then, enter the tag name (or *nickname*) in the **Tag Name:** field.

Next, enter the appropriate operand in the **Allocation Number:** field.

Finally, optionally enter any associated comment in the **Tag Name Comment:** field. This reference may be a maximum of six characters per line for a maximum of four lines.

Once the dialog box is complete, click the **OK** button to display the normally closed instruction on your ladder.


To back out of this instruction without utilizing the normally closed instruction, click the **Cancel** button.

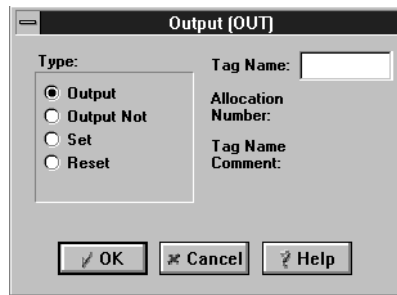
To access on-line help, click the **Help** button.



Right Mouse → Basic Instructions → Output (OUT)

Selecting **Basic Instructions → Output (OUT)** displays the **Output (OUT)** dialog box.

You may also click the toolbar button: 



NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure → PLC Selection** option.

Use the **Output (OUT)** instruction to transfer the result of a bit logical operation to the specified operand.

There is no limit to the number of **OUT** instructions that can be programmed into one rung. However, programming multiple outputs of the same output number is not recommended. If this must be done, separate the outputs with the **Jump (JMP)**, **Jump End (JEND)**, **Master Control Set (MCS)**, or **Master Control Reset (MCR)** set of instructions.

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When the same output address is programmed more than once with one scan, the output nearest to the **END** instruction is given priority.

The following chart provides all OUT operands.

Instruction	Standard	High-Speed
I	—	—
Q	000–031	000–011
M	000–287	000–047
T	—	—
C	—	—
R	—	—



Accept the default, **Output**, in the **Type:** field. Then, enter the tag name (or *nickname*) in the **Tag Name:** field.

Next, enter the appropriate operand in the **Allocation Number:** field.

Finally, optionally enter any associated comment in the **Tag Name Comment:** field. This reference may be a maximum of six characters per line for a maximum of four lines.

Once the dialog box is complete, click the **OK** button to display the OUT instruction on your ladder.


To back out of this instruction without inserting an output, click the **Cancel** button.

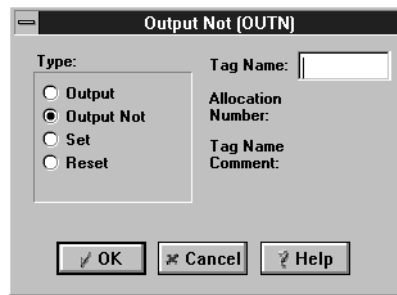
To access on-line help, click the **Help** button.



Right Mouse → Basic Instructions → Output Not (OUTN)

Selecting **Basic Instructions** → **Output Not (OUTN)** displays the **Output Not (OUTN)** dialog box.

You may also click the toolbar button: 



NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure** → **PLC Selection** option.

Use the Output Not (OUTN) instruction to transfer the *inverted* result of a bit logical operation to the specified operand.

There is no limit to the number of OUTN instructions that can be programmed into one rung. However, programming multiple outputs of the same output number is not recommended. If this must be done, separate the outputs with the Jump (JMP), Jump End (JEND), Master Control Set (MCS), or Master Control Reset (MCR) set of instructions.

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When the same output address is programmed more than once in one scan, the output nearest to the END instruction is given priority.

The following chart provides all OUTN operands.

Instruction	Standard	High-Speed
I	—	—
Q	000–031	000–011
M	000–287	000–047
T	—	—
C	—	—
R	—	—



Accept the default, **Output Not**, in the **Type:** field. Then, enter the tag name (or *nickname*) in the **Tag Name:** field.

Next, enter the appropriate operand in the **Allocation Number:** field.

Finally, optionally enter any associated comment in the **Tag Name Comment:** field. This reference may be a maximum of six characters per line for a maximum of four lines.

Once the dialog box is complete, click the **OK** button to display the OUTN instruction on your ladder.


To back out of this instruction without utilizing the OUTN instruction, click the **Cancel** button.

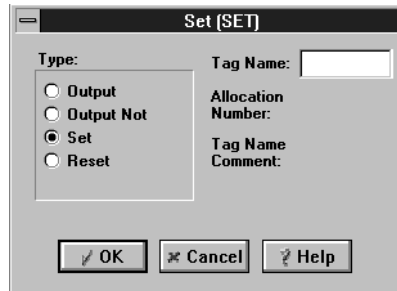
To access on-line help, click the **Help** button.



Right Mouse → Basic Instructions → Set (SET)

Selecting **Basic Instructions → Set (SET)** displays the Set (SET) dialog box.

You may also click the toolbar button: 



NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure → PLC Selection** option.

Use the Set (SET) instruction to set (or turn on) outputs, internal relays, and shift register bits.

The SET instruction requires one address which must be selected from the appropriate operand numbers. The same output can be set and reset many times within a program. SET instructions operate in every scan while the input is on.

The following chart provides all SET operands.

Instruction	Standard	High-Speed
I	—	—
Q	000–031	000–011
M	000–287	000–047
T	—	—
C	—	—
R	000–063	000–031



Accept the default, **Set**, in the **Type:** field. Then, enter the tag name (or *nickname*) in the **Tag Name:** field.

Next, enter the appropriate operand in the **Allocation Number:** field.

Finally, optionally enter any associated comment in the **Tag Name Comment:** field. This reference may be a maximum of six characters per line for a maximum of four lines.

Once the dialog box is complete, click the **OK** button to display the SET instruction on your ladder.


To back out of this instruction without utilizing the SET instruction, click the **Cancel** button.

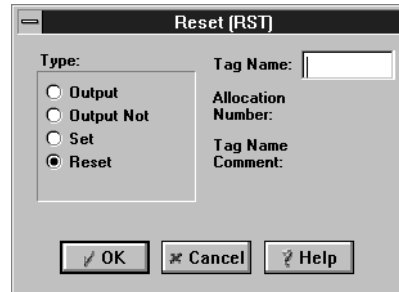
To access on-line help, click the **Help** button.



Right Mouse → Basic Instructions → Reset (RST)

Selecting **Basic Instructions → Reset (RST)** displays the **Reset (RST)** dialog box.

You may also click the toolbar button: 



NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure → PLC Selection** option.

Use the Reset (RST) instruction to reset (or turn off) outputs, internal relays, and shift register bits.

The RST instruction requires one address which must be selected from the appropriate operand numbers. The same output can be set and reset many times within a program. RST instructions operate in every scan while the input is on.

The following chart provides all RST operands.

Instruction	Standard	High-Speed
I	—	—
Q	000–031	000–011
M	000–287	000–047
T	—	—
C	—	—
R	000–063	000–031



Accept the default, **Reset**, in the **Type:** field. Then, enter the tag name (or *nickname*) in the **Tag Name:** field.

Next, enter the appropriate operand in the **Allocation Number:** field.

Finally, optionally enter any associated comment in the **Tag Name Comment:** field. This reference may be a maximum of six characters per line for a maximum of four lines.

Once the dialog box is complete, click the **OK** button to display the RST instruction on your ladder.

To back out of this instruction without utilizing the RST instruction, click the **Cancel** button.

To access on-line help, click the **Help** button.



Right Mouse → Basic Instructions → Single Output

Selecting **Basic Instructions → Single Output → Single Output Up (SOTU)** displays the SOTU icon within the selected area of the ladder. (The selected area appears as a shaded gray square.)

To select the SOTU instruction, you may also click the toolbar button:



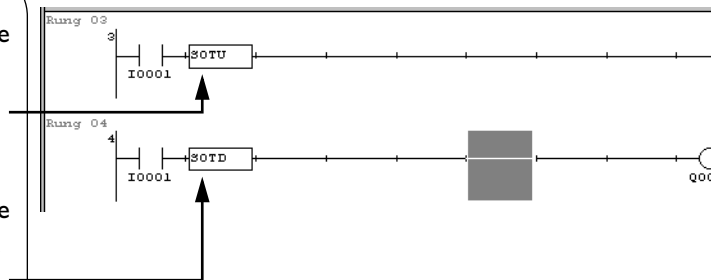
Selecting **Basic Instructions → Single Output → Single Output Down (SOTD)** displays the SOTD icon within the selected area of the ladder. (The selected area appears as a shaded gray square.)

To select the SOTD instruction, you may also click the toolbar button:



The SOTU instruction displays by selecting the **Single Output Up** instruction with the right mouse button.

The SOTD instruction displays by selecting the **Single Output Down** instruction with the right mouse button.



NOTE: When using the Micro-1, only the SOT option is available. The SOT option is the same as the SOTU option. The SOTD option is not available with the Micro-1.

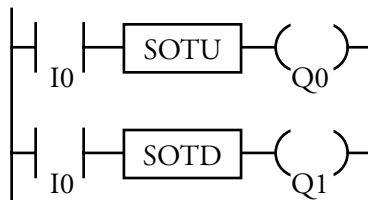
The Single Output Up (SOTU) instruction looks for the transition of a given input from off to on. The Single Output Down (SOTD) instruction looks for the transition of a given input from on to off.

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There is not limit to the number of SOTU and SOTD instructions that can be in a program.

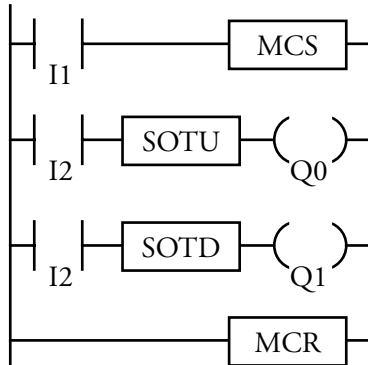
NOTE: If an operation starts while the given input is already on, the SOTU output will not turn on. The *transition* from off to on is what triggers the SOTU instruction.

When a relay is defined as the SOTU or SOTD output, it may not operate if the scan time is not compatible with relay requirements.



NOTE for MCS instructions: If input I2 to the SOTU instruction turns on while input I1 to the Master Control Set (MCS) instruction is on, then the SOTU output turns on. If input I2 to the SOTU instruction turns off while input I1 is on, then the SOTD output turns on.

If input I1 turns on while input I2 is on, then the SOTU output turns on. However, if input I1 turns off while input I2 is on, the SOTD output does **not** turn on.



Right Mouse → Basic Instructions → Timer

Selecting **Basic Instructions → Timer → 100 msec Timer (TIM)** displays the 100 msec Timer (TIM) dialog box.

Selecting **Basic Instructions → Timer → 10 msec Timer (TMH)** displays the 10 msec Timer (TMH) dialog box.

Selecting **Basic Instructions → Timer → 1 msec Timer (TMS)** displays the 1 msec Timer (TMS) dialog box.

You may also click the toolbar button:




Click the circle to the left of the appropriate selection in the **Type:** field: either **100 msec**, **10 msec**, or **1 msec**.

Then, enter the tag name (or *nickname*) in the **Tag Name:** field. Next, enter the appropriate operand in the **Allocation Number:** field.

In the **Preset Value:** field, enter the amount of time to which the timer times down.

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Finally, optionally enter any associated comment in the **Tag Name Comment:** field. This reference may be a maximum of six characters per line for a maximum of four lines.

Once the dialog box is complete, click the **OK** button to display the timer instruction on your ladder. To back out of this instruction without setting up a timer, click the **Cancel** button.

To access on-line help, click the **Help** button.

NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure → PLC Selection** option.

Three types of timers are available: 100 msec countdown timer (TIM), 10 msec countdown timer (TMH), and 1 msec countdown timer (TMS).

A total of 32 timers and counters can be programmed in the standard processing mode. Each timer must be allocated to a unique number, 0 through 31. The same number cannot be allocated for counters. In high-speed mode, timer numbers 0 through 15 are available.

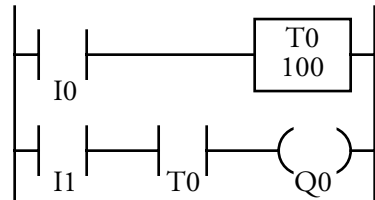
The following table provides information about each available timer.



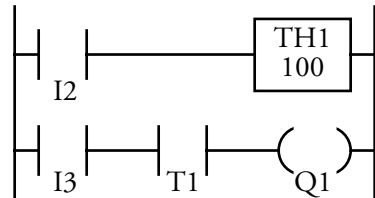
Timer	TIM (100 msec)	TMH (10 msec)	TMS (1 msec)
Allocation Number	TIM0–TIM31	TIMH0–TIMH31	TIMS0–TIMS31
Range	0–999.9 sec	0–99.99 sec	0–9.999 sec
Increments	100 msec	10 msec	1 msec
Preset Value	0 to 9999 Data registers D0 to D99 (standard mode) Data registers D0 to D31 (high-speed mode)		

Examples of timer ladder diagrams are as follows:

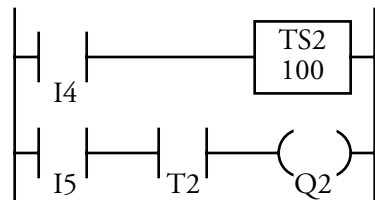
100 msec Timer (TIM)



10 msec Timer (TMH)



1 msec Timer (TMS)

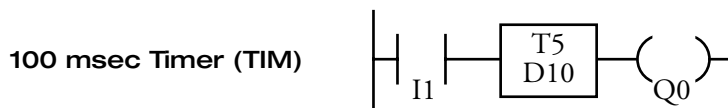


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Timer Circuit

The preset value 0–9999 can be designated using a data register D0–D99 in the standard mode or D0–D31 in the high-speed mode. When a data register is used, the information in the data register becomes the preset value.

Enter the TIM, TMH, or TMS instruction with the two required addresses. Then, enter the output (OUT) instruction.



- Countdown from the preset value is initiated when the operation results directly before the timer input is on.
- The timer output turns on when the timed value reaches zero.
- The timed value returns to the preset value when the timer input is off.
- The same timer or counter number cannot be programmed more than once. In this event, an error message will result.
- Timer preset values can be changed without transferring the entire program to the PLC base unit again. If the timer preset value is changed during time-down, the timer remains unchanged for one cycle. The change will be reflected in the next cycle.
- If the timer preset value is changed to zero, then the timer stops operation and the timer output is turned on immediately.

Right Mouse → Basic Instructions → Counter

Selecting **Basic Instructions → Counter → Up Counter (CNT)** displays the **Up Counter (CNT)** dialog box.

Selecting **Basic Instructions → Counter → Dual Pulse Counter (CDP)** displays the **Dual Pulse Counter (CDP)** dialog box.

Selecting **Basic Instructions → Counter → Up/Down Counter (CUD)** displays the **Up/Down Counter (CUD)** dialog box.

You may also click the toolbar button:




Click the circle to the left of the appropriate selection in the **Type:** field: either **Up**, **Dual Pulse**, or **Up/Down**.

Then, enter the tag name (or *nickname*) in the **Tag Name:** field. Next, enter the appropriate operand in the **Allocation Number:** field.

In the **Preset Value:** field, enter the quantity to which the counter counts up.

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Finally, optionally enter any associated comment in the **Tag Name Comment:** field. This reference may be a maximum of six characters per line for a maximum of four lines.

Once the dialog box is complete, click the **OK** button to display the counter instruction on your ladder. To back out of this instruction without setting up a counter, click the **Cancel** button.

To access on-line help, click the **Help** button.

NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure → PLC Selection** option.

Three types of counters are available: dual pulse reversible counter (CNT0), up/down selection reversible counter (CNT1), and adding (up) counters (CNT2–CNT31).

A total of 32 timers and counters can be programmed in the standard processing mode. Each counter must be allocated to a unique number (0–31). The same number cannot be used for timers. In the high-speed processing mode, counter numbers 0–15 are available.

The following table provides information about each available counters.



Counter	Allocation Number	Preset Value
Dual-Pulse Reversible Counter	CNT0	0 to 9999
Up/Down Selection Reversible Counter	CNT1	Data registers D0 to D99 (standard mode)
Adding (Up) Counter	CNT2–CNT31 (standard mode) CNT2–CNT15 (high-speed mode)	Data registers D0 to D31 (high-speed mode)

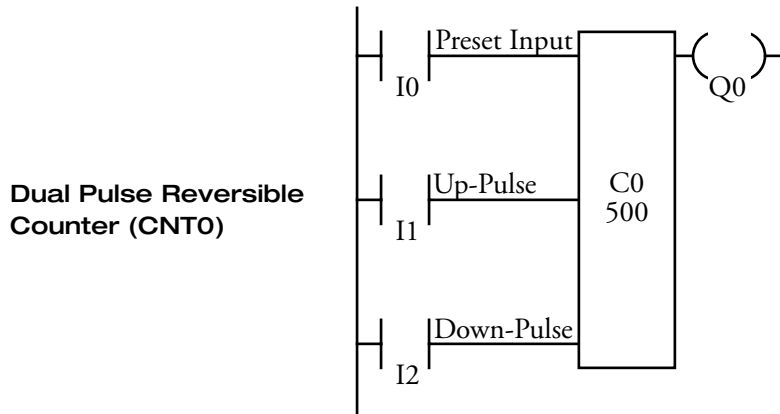
Dual Pulse Reversible Counter (CNT0)

These counters have up and down pulse inputs, so that three inputs are required. The circuit for a dual-pulse counter must be programmed in the following order:

10. Preset input
11. Up-pulse input
12. Down-pulse input
13. CNT0 instruction
14. Counter preset value from 0 to 9999



The preset value can be designated with a constant or data register. When a data register is used, the information in the data register becomes the preset value.



- The same counter or timer number cannot be programmed more than once.
- When the up-pulse and down-pulse are on simultaneously, no pulse is counted.
- When the preset input is on, the preset value is set.
- When the preset input is off, counting starts.
- The counter output is on only when the counted value is zero.
- After the counted value reaches zero (counting down), it changes to 9999 on the next count down.
- After the counted value reaches 9999 (counting up), it changes to zero on the next count up.
- The preset input must be turned on initially, so that the counted value returns to the preset value.
- The preset input must be turned off before counting may begin.
- When the preset value is changed during a counter operation, the change becomes effective immediately.

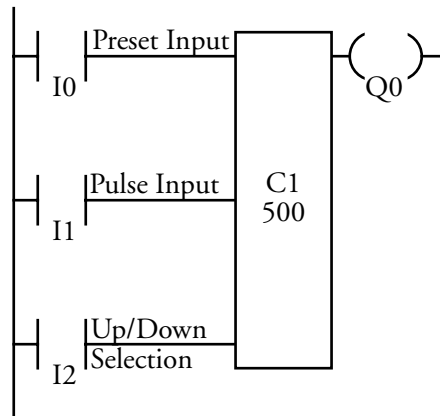
Up/Down Selection Reversible Counter (CNT1)

These counters have selection inputs to switch the up/down gate, so that three inputs are required. The circuit for a selection counter must be programmed in the following order:

1. Preset input
2. Up/down pulse input
3. Selection input
4. CNT1 instruction
5. Counter preset value from 0 to 9999

The preset value can be designated with a constant or data register. When a data register is used, the information in the data register becomes the preset value.

**Up/Down Selection
Reversible Counter
(CNT1)**



- The same counter or timer number cannot be programmed more than once.
- The up mode is selected when the up/down selection input is on.
- The down mode is selected when the up/down selection input is off.
- When the preset input is on, the preset value is set.

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- The counter output is on only when the counted value is zero.
- After the counted value reaches zero (counting down), it changes to 9999 on the next count down.
- After the counted value reaches 9999 (counting up), it changes to zero on the next count up.
- The preset input must be turned on initially, so that the counted value returns to the preset value.
- The preset input must be turned off before counting may begin.
- When the preset value is changed during a counter operation, the change becomes effective immediately.

Adding (Up) Counters (CNT2-CNT31)

Standard counter circuits, using the CNT instruction, feature an adding (UP) counter. There are 30 adding counters (CNT2–CNT31) in the standard processing mode or 14 adding counters in the high-speed mode.

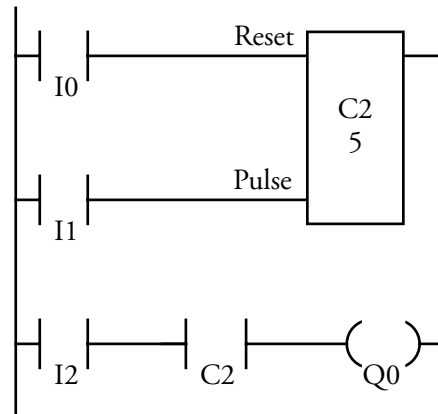
When counter instructions are programmed, two addresses are required. The circuit for a adding (UP) counter must be programmed in the following order:

1. Reset input
2. Pulse input
3. CNT instruction
4. Counter number from 2 to 31
5. Counter preset value from 0 to 9999



The preset value can be designated with a constant or data register. When a data register is used, the information in the data register becomes the preset value.

**Adding (UP)
Counter (CNT2 to 31)**



- The same counter or timer number cannot be programmed more than once.
- While the reset input is off, the counter counts the leading edges of pulse inputs and compares them with the preset value.
- When the counted value reaches the preset value, the counter turns the output on. The output stays on until the reset input is turned on.
- When the reset input changes from off to on, the counted value is reset.
- When the reset input is on, all pulse inputs are ignored.
- The reset input must be turned off before counting may begin.
- When the power is off, the counter's counted value is maintained.
- Counter preset values can be changed without transferring the entire program to the PLC base unit.
- When the preset value is changed during the counter's operation, the change becomes effective immediately.
- The reset input has priority over the pulse input. Within one scan after the reset input has changed from on to off, the counter starts counting the pulse inputs as they change from off to on.

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Right Mouse → Basic Instructions → Shift Register

Selecting **Basic Instructions → Shift Register → Forward (SFR)** displays the Forward Shift Register (SFR) dialog box.

Selecting **Basic Instructions → Shift Register → Reverse (SFRN)** displays the Reverse Shift Register (SFRN) dialog box.

You may also click the toolbar button:




Click the circle to the left of the appropriate selection in the **Type:** field: either **Forward** or **Reverse**.

Then, enter the tag name (or *nickname*) in the **Tag Name:** field. Next, enter the appropriate operand in the **Allocation Number:** field.

In the **Preset Value:** field, enter the number of bits to shift.

Finally, optionally enter any associated comment in the **Tag Name Comment:** field. This reference may be a maximum of six characters per line for a maximum of four lines.

Once the dialog box is complete, click the **OK** button to display the shift register instruction on your ladder.

To back out of this instruction without setting up a shift register, click the **Cancel** button.

To access on-line help, click the **Help** button.

NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure → PLC Selection** option.

Two types of shift registers are available: forward (SFR) and reverse (SFRN). A total of 64 bits are allocated to R0 through R63 in the standard processing mode. In the high-speed processing mode, 32 bits are available for the shift register allocated to R0 through R31.

Any number of available bits can be selected to form a train of bits which store the on or off status. The on/off data of constituent bits is shifted in the forward direction (forward shift register) or in the reverse direction (reverse shift register) when a pulse input is turned on.

Forward Shift Register (SFR)

When SFR instructions are programmed, two addresses are always required. Enter the SFR instruction, followed by a shift register number selected from the appropriate operand numbers. The shift register number corresponds to the first bit. The number of bits is the second required address after the SFR instruction.



The SFR instruction requires three inputs. The forward shift register circuit must be programmed in the following order:

1. Reset input (returns the value of each bit to zero)
2. Pulse input (triggers the data to shift upon the leading edge of a pulse)
3. Data input (the information shifted into the first bit in a forward shift register or into the last bit in a reverse shift register)
4. SFR instruction
5. Two required addresses

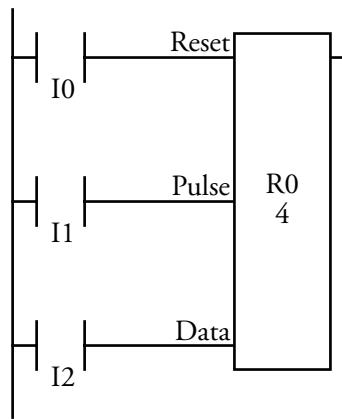
Forward Shift Register (SFR)

First Bit:

- 0–63 (standard processing mode)
- 0–31 (high-speed processing mode)

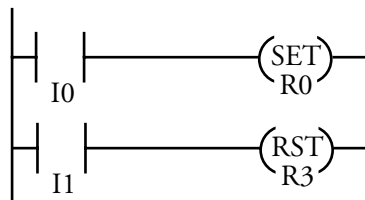
Number of Bits:

- 1–64 (standard processing mode)
- 1–32 (high-speed processing mode)



NOTE: When power is turned off, the statuses of all shift register bits are normally cleared. It is also possible to maintain the statuses of the shift register bits by setting FUN4 as required.

Example:
SFR Set and Reset



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- Any shift register bit can be turned on using the SET instruction.
- Any shift register bit can be turned off using the RST instruction.
- The SET and RST instruction is actuated by any input condition
- The last bit status output can be programmed directly after entering the SFR instruction with two required addresses. In this example, the status of bit R3 is read to output Q3.
- Each bit can be loaded using the LOD R# instructions.

Reverse Shift Register (SFRN)

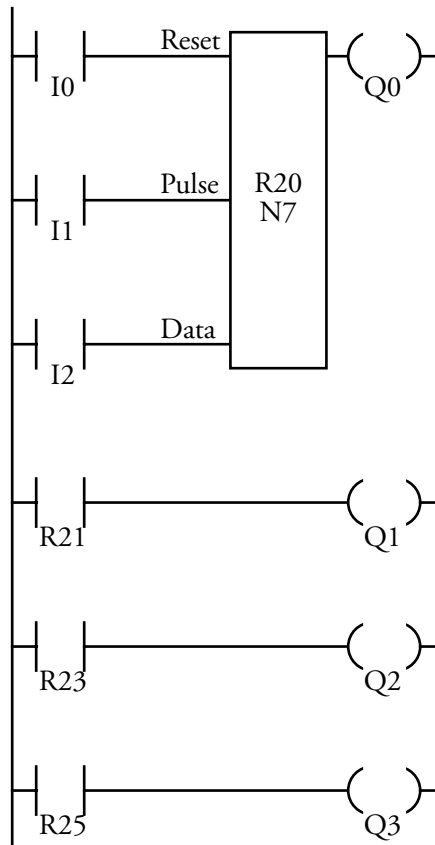
For reverse shifting, use the SFR instruction followed by the NOT instruction. When SFRN instructions are programmed, two addresses are always required. Enter the SFR and NOT instructions, followed by a shift register number selected from the appropriate operand numbers. The shift register number corresponds to the lowest bit number in the string. The number of bits is the second required address after the SFR NOT instructions.

The SFRN instruction requires three inputs. The reverse shift register circuit must be programmed in the following order:

1. Reset input
2. Pulse input
3. Data input
4. SFR and NOT instructions
5. Two required addresses



Reverse Shift Register (SFRN)

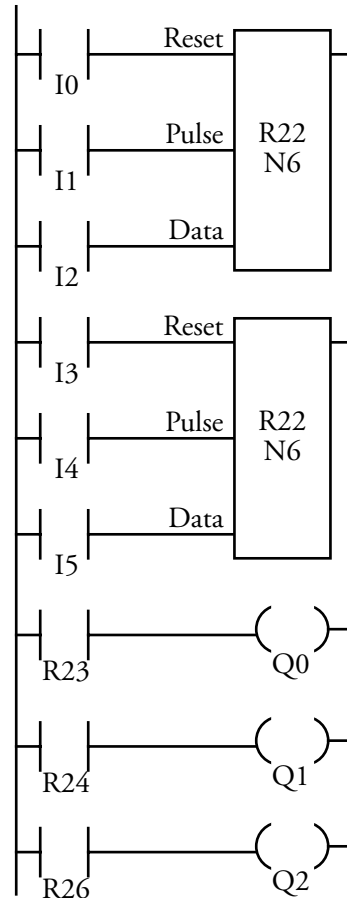


- The last bit status output can be programmed directly after the SFRN instruction with two required addresses entered. In this example, the status of bit R20 is read to output Q0.
- Each bit can be loaded using the LOD R# instructions.

Bi-Directional Shift Register

A bi-directional shift register can be created by first entering in the SFR instruction (with two addresses) as explained in the *Forward Shift Register (SFR)* section on page 9-34. Then, enter the SFR and NOT instructions (with two addresses) as explained in the *Reverse Shift Register (SFRN)* section on page 9-36.

Bi-Directional Shift Register



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Right Mouse → Basic Instructions → Counter Comparison

Selecting **Basic Instructions → Counter Comparison → Equal (CC=)** displays the **Counter Comparison (CC=)** dialog box.

Selecting **Basic Instructions → Counter Comparison → Greater Than or Equal (CC>=)** displays the **Counter Comparison (CC>=)** dialog box.

You may also click the toolbar button:




Click the circle to the left of the appropriate selection in the **Type:** field: either **Equal** or **Greater/Equal**.

Then, enter the tag name (or *nickname*) in the **Tag Name:** field. Next, enter the appropriate operand in the **Allocation Number:** field.

In the **Preset Value:** field, enter the value to which the selected counters will be compared.

Finally, optionally enter any associated comment in the **Tag Name Comment:** field. This reference may be a maximum of six characters per line for a maximum of four lines.

Once the dialog box is complete, click the **OK** button to display the counter comparison instruction on your ladder.

To back out of this instruction without setting up a counter comparison instruction, click the **Cancel** button.

To access on-line help, click the **Help** button.

NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure → PLC Selection** option.

The **CC=** instruction is an equivalent comparison instruction for counted values. This instruction will constantly compare counted values to the value that has been programmed. When the counter value equals the given value, the coil turns on.

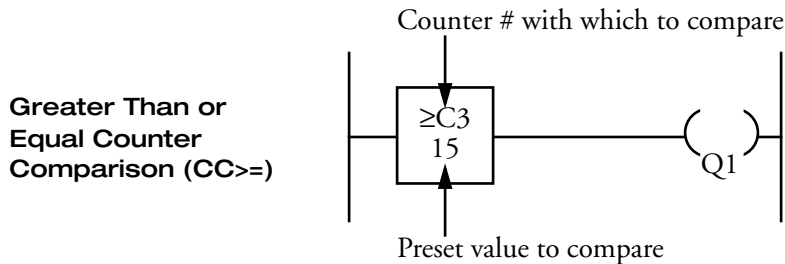
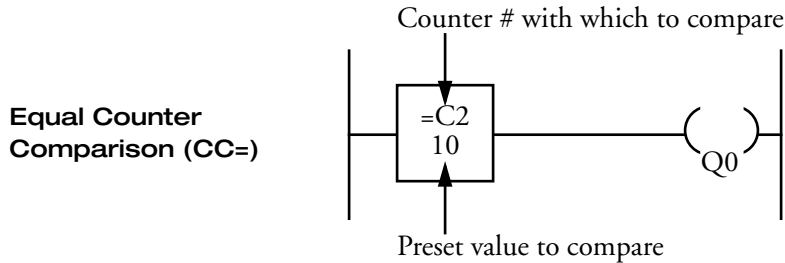
The **CC>=** instruction is an equal to or greater than comparison instruction for counted values. This instruction will constantly compare counted values to the value that has been programmed. When the counter value is equal to or greater than the given value, the coil turns on.

When a counter comparison instruction is programmed, two addresses are required. The circuit for a counter comparison must be programmed in the following order:

The logo for IDEC, consisting of the lowercase letters 'idec' in a bold, sans-serif font. The 'i' and 'd' are connected, and the 'e' and 'c' are also connected. The letters are a dark grey color.

1. CC= or CC>= instruction
2. Counter number 0 through 31
3. Preset value to compare from 0 to 9999 (decimal constant or data register)

Data registers D0 through D99 are available in the standard processing mode and D0 through D31 in the high-speed processing mode.



- The CC= and CC>= instructions can be used repeatedly for different preset values.
- The comparison instructions only compare the counted value. The status of the counter does not affect this function.
- The comparison instructions also serve as an implicit LOD instruction.

- Like the LOD instruction, the comparison instructions can be followed by the AND or OR instructions.
- Another way to accomplish the above is to use comparison instructions which are then followed by the AND LOD or OR LOD instructions.

Right Mouse → Basic Instructions → Program Flow → Master Control Set (MCS) and Master Control Reset (MCR)

Selecting Basic Instructions → Program Flow → Master Control Set (MCS) automatically displays the instructions associated with the master control set.

You may also click the toolbar button:



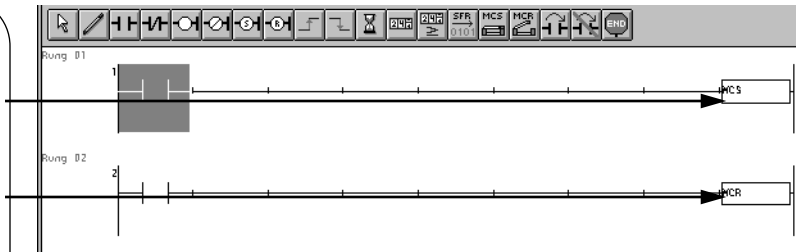
Selecting Basic Instructions → Program Flow → Master Control Reset (MCR) automatically displays the instructions associated with the master control reset.

You may also click the toolbar button:



The MCS function displays when selecting Master Control Set (MCS).

The MCR function displays when selecting Master Control Reset (MCR).



NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure → PLC Selection** option.

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The MCS instruction is usually used in combination with the MCR instruction. The MCS instruction can also be used with the END instruction instead of the MCR instruction.

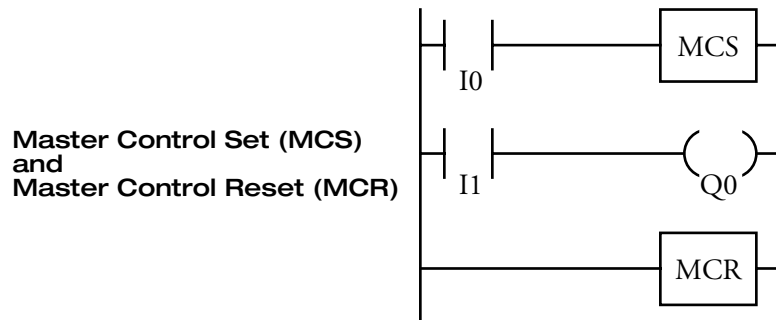
When the input preceding the MCS instruction is off, the MCS is executed so that all inputs between the MCS and the MCR are forced off. When the input preceding the MCS instruction is on, the MCS is not executed so that the program following it is executed according to the actual input statuses.

When the input condition to the MCS instruction is off and the MCS is executed, other instructions between the MCS and MCR are executed as follows.

Instruction	Status
CNT	Current values are held; pulse inputs are turned off; count-out statuses are turned off
OUT	All are turned off
OUTN	All are turned on
SET and RST	All are held in the current status
SFR	Shift register bit statuses are held; pulse inputs are turned off; the output from the last bit is turned off
SOTD	Falling edges (OFF pulses) are not detected
SOTU	Rising edges (ON pulses) are not detected
TIM, TMH, and TMS	Current values are reset to zero; time-out statuses are turned off



- Input conditions cannot be set for the MCR instruction.
- More than one MCS instruction can be used with one MCR instruction.
- Corresponding MCS/MCR instructions cannot be nested within another pair of corresponding MCS/MCR instructions.



Multiple Usages of MCS Instructions

This master control circuit will give corresponding priority to I1, I3, and I5.

When input I1 is off, the first MCS is executed so that subsequent inputs I2 through I6 are forced off.

When input I1 is on, the first MCS is *not* executed so that subsequent programs are executed according to the actual input statuses of I2 through I6.

When I1 is on and I3 is off, the second MCS is executed so that subsequent inputs I4 through I6 are forced off.

When both I1 and I3 are on, the first and second MCS are not executed so that the following program is executed according to the actual input statuses of I4 through I6.

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Counter and Shift Register in Master Control Circuit

When input I0 is off, MCS is executed so that the subsequent input is forced off. When input I0 is on, MCS is not executed so that the following program is executed according to the actual input statuses.


NOTE: Pressing the MCS/R key on the program loader programs the MCS or MCR instruction alternately.

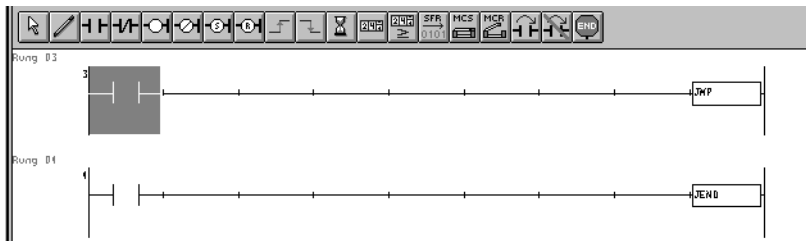
Right Mouse → Basic Instructions → Program Flow → Jump (JMP) and Jump End (JEND)

Selecting **Basic Instructions** → **Program Flow** → **Jump (JMP)** automatically displays the instructions associated with the jump.

You may also click the toolbar button: 

Selecting **Basic Instructions** → **Program Flow** → **Jump End (JEND)** automatically displays the instructions associated with the jump end.

You may also click the toolbar button: 



NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure** → **PLC Selection** option.

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The JMP instruction is usually used in combination with the JEND instruction. At the end of a program, the JMP instruction can also be used with the END instruction, instead of the JEND instruction.

These instructions are used to proceed through the portion of the program between the JMP and JEND without processing.

When the operation instruction immediately before the JMP instruction is on, the JMP is valid and the program is not executed. When the operation result immediately before the JMP instruction is off, the JMP is invalid and the program is executed.

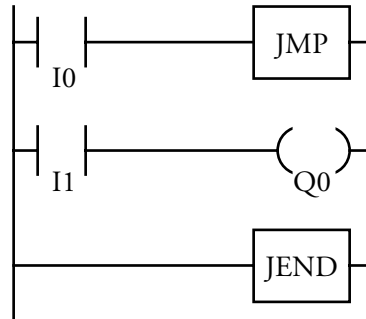
When the input condition to the JMP instruction is on and the JMP is executed, other instructions between the JMP and JEND are executed as follows.

Instruction	Status
SOTU	Rising edges (ON pulses) are not detected
SOTD	Falling edges (OFF pulses) are not detected
OUT and OUTN	All are held in the current status
SET and RST	All are held in the current status
TIM, TMH, and TMS	Current values and time-out statuses are held
CNT	Current values are held; pulse inputs are turned off; count-out statuses held
SFR	Shift register bit statuses are held; pulse inputs are turned off; the output from the last bit is held



- Input conditions cannot be set for the JEND instruction.
- More than one JMP instruction can be used with one JEND instruction.
- Corresponding JMP/JEND instructions cannot be nested within another pair of corresponding JMP/JEND instructions.

**Jump (JMP)
and
Jump End (JEND)**

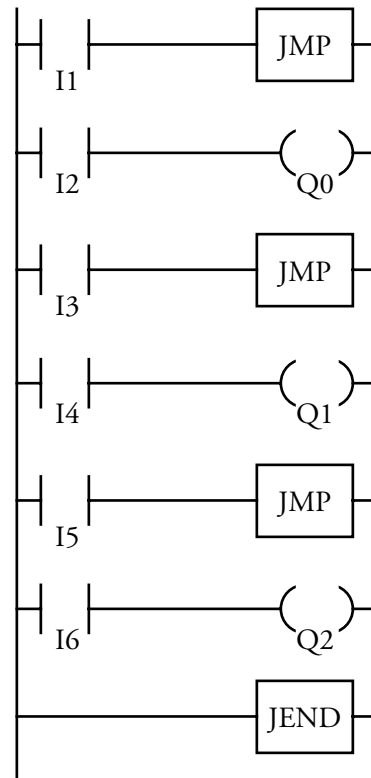


In the above example, when input I0 is on, JMP is executed so that the subsequent output status is held.

When input I0 is off, JMP is *not* executed so that subsequent programs are executed according to the actual input statuses.

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**Example:
Jump (JMP) and
Jump End (JEND)**



This jump circuit will give corresponding priority to I1, I3, and I5.

When input I1 is on, the first JMP is executed so that the subsequent output statuses of Q0 through Q2 are held.

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When input I1 is off, the first JMP is not executed so that the following program is executed according to the actual input statuses of I2 through I6.

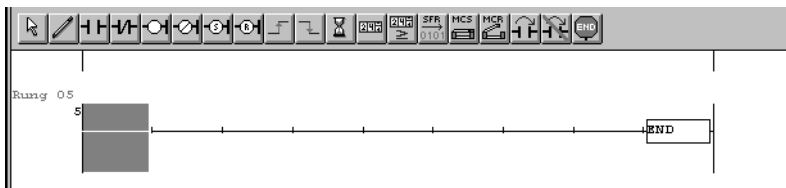
When I1 is off and I3 is on, the second JMP is executed so that the subsequent output statuses of Q1 and Q2 are held.

When both I1 and I3 are off, the first and second JMPs are not executed so that the following program is executed according to the actual input statuses of I4 through I6.

Right Mouse → Basic Instructions → Program Flow → End (END)

Selecting **Basic Instructions → Program Flow → End (END)** automatically displays the instructions associated with the end.

You may also click the toolbar button:



NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure → PLC Selection** option.

The END instruction is always required at the end of a program. However, it is not necessary to program the END instruction after the last programmed instruction. The END instruction already exists at every unused address. (When an address is used for programming, the END instruction is removed.)

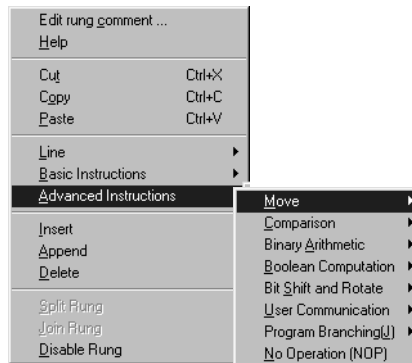
A scan is the execution of all instructions from address zero to the END instruction. The time required for this execution is referred to as one scan time. The scan time varies with respect to program length, which corresponds to the address where the END instruction is found.

During the scan time, program instructions are processed sequentially. This is why the output instruction closest to the END instruction has priority over a previous instruction for the same output. No output is initiated until all logic within a scan is processed.

Output, occurring simultaneously, is the first part of the END instruction execution. The second part of the END instruction execution is to monitor all inputs, also done simultaneously. Then, program instructions are ready to be processed sequentially once again.

Right Mouse → Advanced Instructions

Selecting **Advanced Instructions** with the right mouse button accesses the Advanced Instructions sub-menu.



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NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure → PLC Selection** option.

Group	#	Symbol	Name	Addr's	Available on
NOP	0	NOP	No operation	1	All Micro ³ base units
Move	11	MOV	Move	3 or 4	All Micro ³ base units
	12	MOVN	Move not	3 or 4	
	13	IMOV	Indirect move	5 or 6	
	14	IMOVN	Indirect move not	5 or 6	
	—	Macro	Macro instruction	—	
Com- parison	21	CMP=	Compare equal to	4 or 5	All Micro ³ base units
	22	CMP<>	Compare unequal to	4 or 5	
	23	CMP<	Compare less than	4 or 5	
	24	CMP>	Compare greater than	4 or 5	
	25	CMP<=	Compare less than or equal to	4 or 5	
	26	CMP>=	Compare greater than or equal to	4 or 5	



Com- parison (continued)	B3	CMP2	Double-word comparison	4 or 5	Micro ³ C only
Binary Arithmetic	31	ADD	Addition	4 or 5	All Micro ³ base units
	32	SUB	Subtraction	4 or 5	
	33	MUL	Multiplication	4 or 5	
	34	DIV	Division	4 or 5	
Boolean Computa- tion	41	ANDW	And word	4 or 5	All Micro ³ base units
	42	ORW	Or word	4 or 5	
	43	XORW	Exclusive or word	4 or 5	
Bit Shift and Rotate	51	SFTL	Shift left	3	All Micro ³ base units
	52	SFTR	Shift right	3	
	53	ROTL	Rotate left	3	
	54	ROTR	Rotate right	3	
Real-Time Calendar	71	CALR	Calendar read	2	16- and 24- point types only
	72	CALW	Calendar write	2	
Clock	73	CLKR	Clock read	2	16- and 24- point types only
	74	CLKW	Clock write	2	
	75	ADJ	Adjust	1	

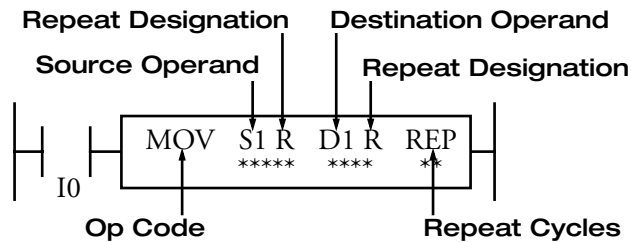


Interface	81	DISP	Display	4	All Micro ³ base units
	82	DGRD	Digital switch read	4	
	83	ANR0	Analog read 0	2	
	84	ANR1	Analog read 1	2	16- and 24- point types only
Pulse and A/D Conversion	91	PULS	Pulse output	3	All Micro ³ base units
	92	PWM	Pulse width modulation	3	
	93	A/D	Analog to digital conversion	2	
High- Speed Counter	A1	HSC0	High-speed counter 0 (32 bits)	4	All Micro ³ base units
	A2	HSC1	High-speed counter 1 (32 bits)	2	
	A3	HSC2	High-speed counter 2 (32 bits)	4	
	A4	HSC3	High-speed counter 3 (16 bits)	2	
Commu- nication	B1	TXD	Transmit	Depends upon the data	Micro ³ C only
	B2	RXD	Receive		



Structure of an Advanced Instruction

The source operand specifies the 16-bit word data to be processed by the advanced instruction. Some advanced instructions require two source operands.

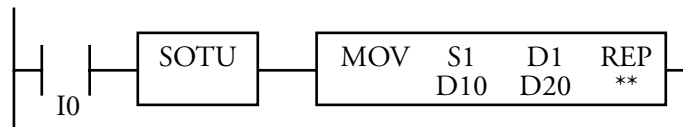


A repeat designation specifies whether the repeat is used for the operand or not.

Input Condition for Advanced Instructions

Almost all advanced instructions must be preceded by a contact, except no operation (NOP) and high-speed counter (HSCO–HSC3) instructions. The input condition can be programmed using a bit operand such as input, output, internal relay, or shift register. Timers and counters can also be used as input conditions to turn on the contact when the timer times out or the counter counts out.

While the input condition is on, the advanced instruction is executed in each scan. To execute the advanced instruction only at the rising or falling edge of the input, use the SOTU or SOTD instruction.



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Source and Destination Operands

The source and destination operands specify 16-bit word data. When a bit operand such as input, output, internal relay, or shift register is designated as a source or destination operand, 16 points (starting with the designated number) are processed as source or destination data.

When a word operand such as timer or counter is designated as a source operand, the current value is read as source data. When a timer or counter is designated as a destination operand, the result of the advanced instruction is set to the preset value for the timer or counter. When a data register is designated as a source or destination operand, the data is read from or written to the designated data register.

Using a Timer or Counter as a Source Operand

Since all timer instructions TIM (100 msec timer), TMH (10 msec timer), and TMS (1-msec timer) subtract from the preset value, the current value is decremented from the preset value and indicates the remaining time. As described above, when a timer is designated as a source operand of an advanced instruction, the current value (or the remaining time) of the timer is read as source data.

Reversible counters CO and C1 start counting at the preset value, and the current value is incremented or decremented from the preset value. Adding counters C2 through C31 start counting at 0, and the current value is incremented up to the preset value. When any counter is designated as a source operand of an advanced instruction, the current value is read as source data.



Using a Timer or a Counter as Destination Operand

As described previously, when a timer or counter is designated as the destination operand of an advanced instruction, the result of the advanced instruction is set to the preset value of the timer or counter. Since timer and counter preset values can be 0 through 9999, make sure that the result of the advanced instruction does not exceed 9999. If the result to be set to a timer or counter designated as the destination exceeds 9999, a user program execution error will result; then, error indicator ERR1 is lit, and special internal relay M304 turns on.

When a timer or counter preset value is designated using a data register, the timer or counter cannot be designated as the destination of an advanced instruction. When executing such an advanced instruction, a user program execution error will result. If a timer or counter is designated as the destination of an advanced instruction and if the timer or counter is not programmed, then a user program execution error will also result.

NOTE: When a user program execution error occurs, the result is not set to the destination.



Right Mouse → Advanced Instructions → Move → Move

Selecting **Advanced Instructions**→**Move**→**Move (MOV)** displays the **Move (MOV)** dialog box.

You may also click the toolbar button:



Type:	S1	D1	REP
<input checked="" type="radio"/> Move <input type="radio"/> Move Not	Tag Name: I0000 Allocation Number: I0000 <input type="checkbox"/> Repeat	Tag Name: M0020 Allocation Number: M0020 <input type="checkbox"/> Repeat	<input type="checkbox"/>
	Tag Name Comment:	Tag Name Comment:	



Accept the default, **Move**, in the **Type:** field.

Enter the tag name (or *nickname*) in the upper **S1** field. Then, enter the associated operand in the **Allocation Number:** field below. Click the **Repeat** box below, if necessary, to indicate a repeat. This is the operand *from* which data will be moved.

Enter the tag name (or *nickname*) in the upper **D1** field. Then, enter the associated operand in the **Allocation Number:** field below. Click the **Repeat** box below, if necessary, to indicate a repeat. This is the operand *to* which data will be moved.

Optionally, enter any associated comment in the **Tag Name Comment:** field. This reference may be a maximum of six characters per line for a maximum of four lines.

If **Repeat** is selected, enter the number of repeats in the **REP** field.

Once the dialog box is complete, click the **OK** button to display the MOV instruction on your ladder. To back out of this instruction without utilizing the MOV instruction, click the **Cancel** button.

To access on-line help, click the **Help** button.

NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure → PLC Selection** option.

Data can be moved using the move (MOV), move not (MOVN), indirect move (IMOV), or indirect move not (IMOVN) instruction. The moved data is 16-bit word data, and the repeat operation can also be used to increase the quantity of data moved. In the MOV or MOVN instruction, the source and destination operands are designated by S1 and D1 directly. In the IMOV or IMOVN instructions, the source and destination operands are determined by the offset values designated by S2 and D2.

S1 → D1

When input is on, 16-bit word data from operand designated by S1 is moved to operand designated by D1.



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Operands Possible (Standard Processing Mode)

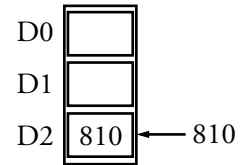
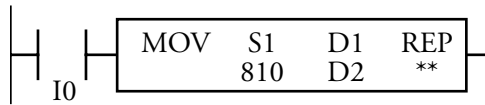
Operand	S1 (Source 1)	D1 (Destination 1)
I	0–35	—
Q	0–31	0–31
M	0–317	0–287
T	0–31	0–31
C	0–31	0–31
R	0–63	0–63
D (Micro ³)	0–99	0–99
D (Micro ³ C)	0–498	0–498
Constant	0–65535	—
Repeat	1–31	1–31

NOTE: When using these operands in the high-speed processing mode, possibilities are limited.

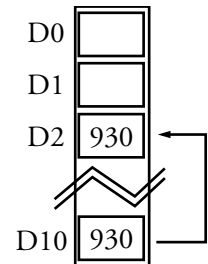
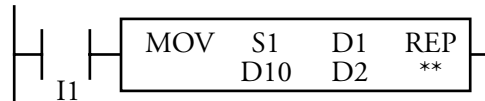
When a timer (T) or counter (C) is used as S1, the timer/counter current value is read out. When a T or C is used as D1, the data is written as a preset value which can be 0 through 9999.

When a bit operand such as an input, output, internal relay, or shift register is used as the source or destination, 16 points are used. When a repeat is designated for a bit operand, the quantity of operand bits increases in 16-point increments.

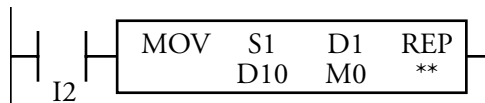


Examples: MOV**810 → D2**

When input I0 is on, constant 810 designated by S1 is moved to data register D2 designated by D1.

D10 → D2

When input I1 is on, the data in data register D10 designated by S1 is moved to data register D2 designated by D1.

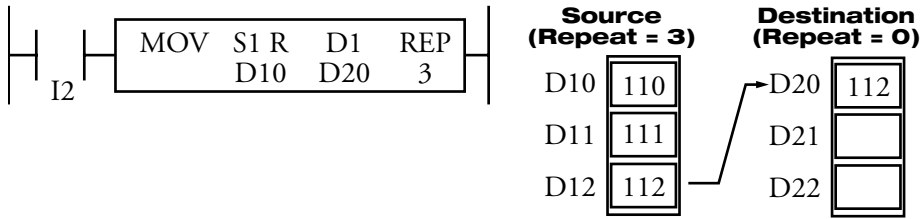
D10 → M0

When input I2 is on, the data in data register D10 designated by S1 is moved to 16 internal relays starting with M0 designated by D1.

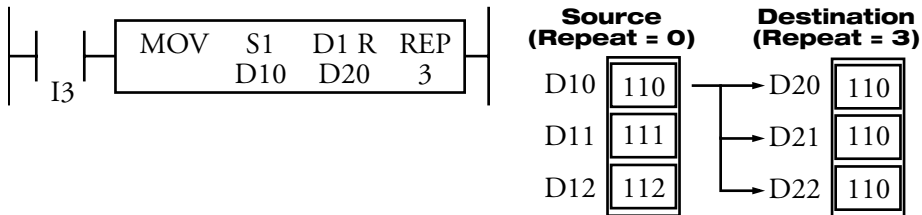
The data in the source data register is converted into 16-bit binary data. The on/off statuses of the 16 bits are moved to internal relays M0 through M7 and M10 through M17. M0 is the least significant bit (LSB), and M17 is the most significant bit (MSB).

Repeat Operation in the Move Instructions

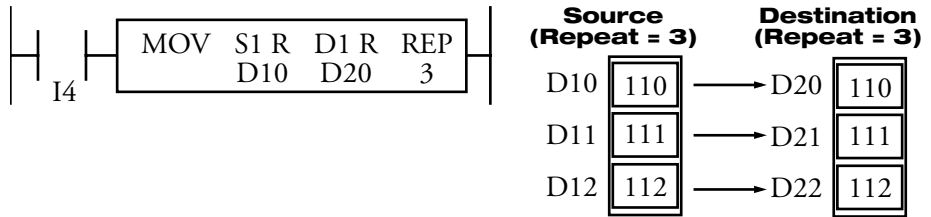
When the source (S) is designated with a repeat, as many operands as repeat cycles (starting with the operand designated by S1) are moved to the destination. As a result, only the last of the source operands is moved to the destination.



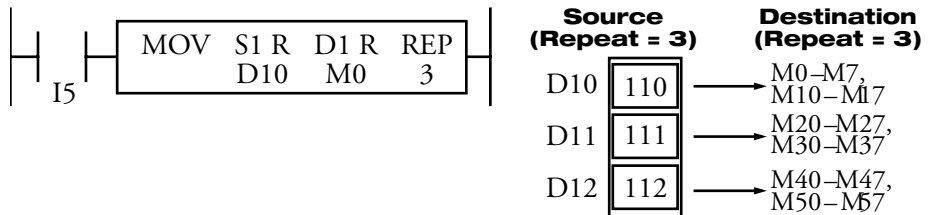
When the destination (D) is designated with a repeat, the source operand designated with S1 is moved to all destination operands (as many as repeat cycles) starting with the destination designated by D1.



When both S and D are designated with a repeat, as many operands as repeat cycles (starting with the operand designated by S1) are moved to the same quantity of operands (starting with the operand designated by D1).

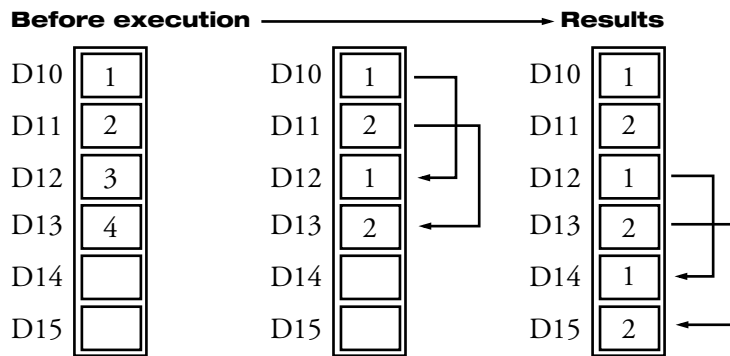
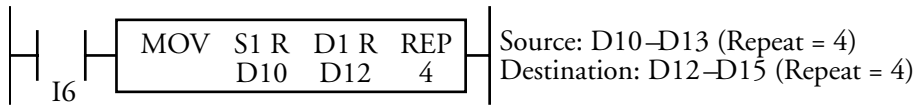


The move (MOV) instruction moves 16-bit word data. When a bit operand such as an input, output, internal relay, or shift register is designated as the source or destination operand, 16 bits (starting with the one designated by S1 or D1) are the target data. If a repeat operation is designated for a bit operand, the target data increases in 16-bit increments.



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If the repeat operation is designated for both the source and destination and if a portion of the source and destination areas overlap each other, then the source data in the overlapped area is also changed.



Right Mouse → Advanced Instructions → Move → Move Not

Selecting **Advanced Instructions → Move → Move Not (MOVN)** displays the **Move Not (MOVN)** dialog box.



Accept the default, **Move Not**, in the **Type:** field.

Enter the tag name (or *nickname*) in the upper **S1** field. Then, enter the associated operand in the **Allocation Number:** field below. Click the **Repeat** box below, if necessary, to indicate a repeat. This is the operand *from* which data will be inverted and moved.

Enter the tag name (or *nickname*) in the upper **D1** field. Then, enter the associated operand in the **Allocation Number:** field below. Click the **Repeat** box below, if necessary, to indicate a repeat. This is the operand *to* which data will be inverted and moved.

Optionally, enter any associated comment in the **Tag Name Comment:** field. This reference may be a maximum of six characters per line for a maximum of four lines.

If **Repeat** is selected, enter the number of repeats in the **REP** field.

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Once the dialog box is complete, click the **OK** button to display the MOVN instruction on your ladder. To back out of this instruction without utilizing the MOVN instruction, click the **Cancel** button.

To access on-line help, click the **Help** button.

NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure → PLC Selection** option.

S1 NOT → D1

When an input is on, 16-bit word data from the operand designated by S1 is inverted bit by bit and moved to the operand designated by D1.



Operands Possible (Standard Processing Mode)

Operand	S1 (Source 1)	D1 (Destination 1)
I	0–35	—
Q	0–31	0–31
M	0–317	0–287
T	0–31	0–31
C	0–31	0–31
R	0–63	0–63
D (Micro ³)	0–99	0–99

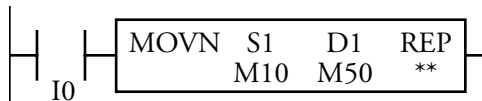
D (Micro ³ C)	0–498	0–498
Constant	0–65535	—
Repeat	1–31	1–31

NOTE: When used in the high-speed processing mode, possible operands are limited.

When a timer (T) or counter (C) is used as S1, the timer/counter current value is read out. When a T or C is used as D1, the data is written in as a preset value which can be 0 through 9999.

When a bit operand such as an input, output, internal relay, or shift register is used as the source or destination, 16 points are used. When a repeat is designated for a bit operand, the quantity of operand bits increases in 16-point increments.

Example: MOVN



M10 NOT → M50

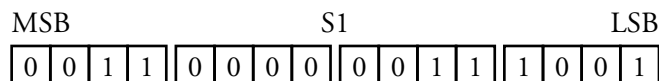
When an input is on, the 16 internal relays starting with M10 designated by S1 are inverted bit by bit and moved to the 16 internal relays starting with M50 designated by D1.

M10-M17, M20-M27 NOT → M50-57, M60-M67

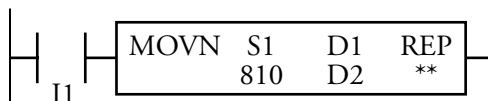
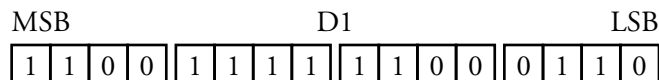
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The on/off statuses of the 16 internal relays, M10–M17 and M20–M27, are inverted and moved to 16 internal relays, M50–M57 and M60–M67. When M50 and M60 are monitored on the program loader, the data is displayed as shown on the right below. M50 is the least significant bit (LSB), and M67 is the most significant bit (MSB).

Before inversion (M17-M0):



After inversion (M67-M50):



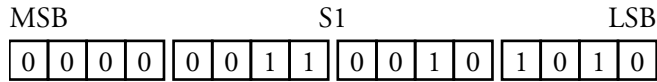
810 NOT → D2

When input I1 is on, constant 810 designated by S1 is inverted bit by bit and moved to data register D2 designated by D1.

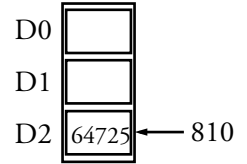
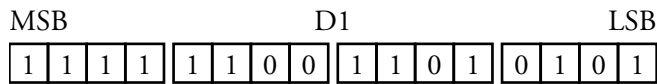
idec

The source data of decimal 810 designated by S1 is converted into 16-bit binary data. The on/off statuses of the 16 bits are inverted and moved to data register D2.

Before inversion (810):

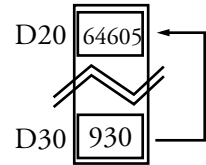


After inversion (64725):




D10 NOT → D2

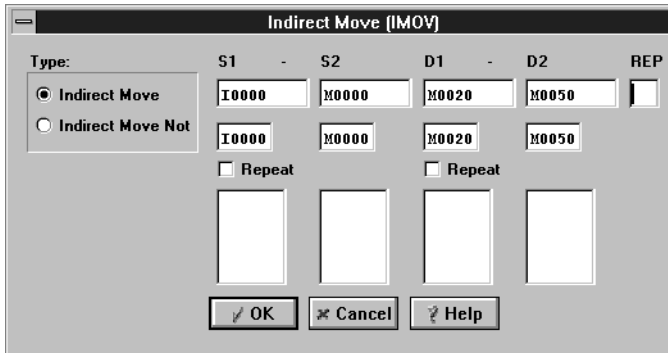
When input I2 is on, that data in data register D10 designated by S1 is inverted bit by bit and moved to data register D2 designated by D1.



Right Mouse → **Advanced Instructions** → **Move** → **Indirect Move (IMOV)**

Selecting **Advanced Instructions** → **Move** → **Indirect Move (IMOV)** displays the **Indirect Move (IMOV)** dialog box.

You may also click the toolbar button: 



Type:	S1	S2	D1	D2	REP
<input checked="" type="radio"/> Indirect Move	I0000	M0000	M0020	M0050	<input type="checkbox"/>
<input type="radio"/> Indirect Move Not	I0000	M0000	M0020	M0050	<input type="checkbox"/>
	<input type="checkbox"/> Repeat		<input type="checkbox"/> Repeat		
	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	
	<input type="button" value="OK"/>	<input type="button" value="Cancel"/>	<input type="button" value="Help"/>		



Accept the default, **Indirect Move**, in the **Type:** field.

Enter the tag name (or *nickname*) in the upper **S1** field. Then, enter the associated operand in the allocation number field below. Click the **Repeat** box below, if necessary, to indicate a repeat. This is the first operand *from* which data will be moved.

Enter the tag name (or *nickname*) in the upper **S2** field. Then, enter the associated operand in the allocation number field below. This is the amount of the offset *from* which data will be moved.



Enter the tag name (or *nickname*) in the upper D1 field. Then, enter the associated operand in the allocation number field below. Click the **Repeat** box below, if necessary, to indicate a repeat. This is the first operand *to* which data will be moved.

Enter the tag name (or *nickname*) in the upper D2 field. Then, enter the associated operand in the allocation number field below. This is the amount of the offset *to* which data will be moved.

Optionally, enter any associated comment in the tag name comment field. This reference may be a maximum of six characters per line for a maximum of four lines.

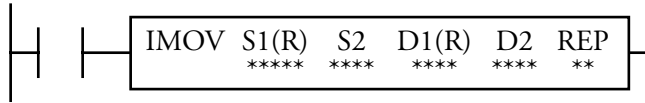
If **Repeat** is selected, enter the number of repeats in the **REP** field.

Once the dialog box is complete, click the **OK** button to display the IMOV instruction on your ladder. To back out of this instruction without utilizing the IMOV instruction, click the **Cancel** button.

To access on-line help, click the **Help** button.

NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure → PLC Selection** option.



S1 + S2 → D1 + D2

When input is on, the values contained in operands designated by S1 and S2 are added to determine the source of data. The 16-bit word data so determined is moved to the destination, which is determined by the sum of values contained in operands designated by D1 and D2.

Operands Possible (Standard Processing Mode)

Operand	S1 (Base address to move from)	S2 (Offset for S1)	D1 (Base address to move to)	D2 (Offset for D1)
I	0-35	0-35	—	0-35
Q	0-31	0-31	0-31	0-31
M	0-317	0-287	0-287	0-287
T	0-31	0-31	0-31	0-31
C	0-31	0-31	0-31	0-31
R	0-63	0-63	0-63	0-63
D (Micro ³)	0-99	0-99	0-99	0-99
D (Micro ³ C)	0-498	0-498	0-498	0-498
Constant	—	—	—	—
Repeat	1-31	—	1-31	—

NOTE: When used in the high-speed processing mode, possible operands are limited.

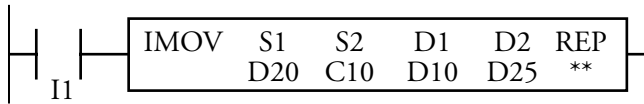
When timer (T) or counter (C) is designated as S1, S2, or D2, the operand data is the current value of the timer/counter. When T or C is designated as D1, the operand data is the timer/counter preset value which can be 0 through 9999.

Make sure that the source data determined by S1 + S2 and the destination data determined by D1 + D2 are within the operand range. If the derived source or destination operand is out of the operand range, a user program execution error will result, turning special internal relay M304 and error indicator ERR1 on.

When a bit operand such as an input, output, internal relay, or shift register is used as the source or destination, 16 points are used. When a repeat is designated for a bit operand, the quantity of operand bits increases in 16-point increments.

Source operand S2 and destination operand D2 do not have to be designated. If S2 or D2 is not designated, the source or destination operand is determined by S1 or D1 without offset.



Example: IMOV**D20 + C10 → D10 + D25**

Source operand S1 and destination operand D1 determine the type of operand. Source operand S2 and destination operand D2 are the offset values to determine the source and destination operands.

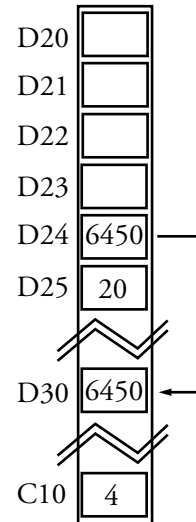
If the current value of counter C10 designated by source operand S2 is 4, then the data is determined by adding the offset to data register D20 designated by source operand S1:

$$D(20 + 4) = D24$$

If data register D25 contains a value of 20, then the destination is determined by adding the offset to data register D10 designated by destination operand D1:

$$D(10 + 20) = D30$$

As a result, when input I0 is on, the data in data register D24 is moved to data register D30.



**Right Mouse → Advanced Instructions → Move →
Indirect Move Not (IMOVN)**

Selecting Advanced Instructions → Move → Indirect Move Not (IMOVN) displays the Indirect Move Not (IMOVN) dialog box.

Type:	S1	S2	D1	D2	REP
<input type="radio"/> Indirect Move	I0000	M0000	M0020	M0050	<input type="checkbox"/>
<input checked="" type="radio"/> Indirect Move Not	I0000	M0000	M0020	M0050	<input type="checkbox"/>
	<input type="checkbox"/> Repeat		<input type="checkbox"/> Repeat		



Accept the default, **Indirect Move Not**, in the **Type**: field.

Enter the tag name (or *nickname*) in the upper **S1** field. Then, enter the associated operand in the allocation number field below. This is the first operand *from* which data will be inverted and moved. Click the **Repeat** box below, if necessary, to indicate a repeat.

Enter the tag name (or *nickname*) in the upper **S2** field. Then, enter the associated operand in the allocation number field below. This is the amount of the offset *from* which data will be inverted and moved.

Enter the tag name (or *nickname*) in the upper **D1** field. Then, enter the associated operand in the allocation number field below. This is the first operand *to* which data will be inverted and moved. Click the **Repeat** box below, if necessary, to indicate a repeat.

idec

Enter the tag name (or *nickname*) in the upper **D2** field. Then, enter the associated operand in the allocation number field below. This is the amount of the offset *to* which data will be inverted and moved.

Optionally, enter any associated comment in the tag name comment field. This reference may be a maximum of six characters per line for a maximum of four lines.

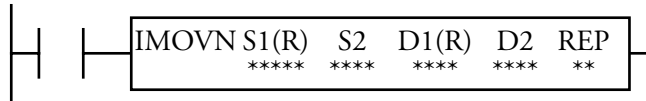
If **Repeat** is selected, enter the number of repeats in the **REP** field.

Once the dialog box is complete, click the **OK** button to display the **IMOVN** instruction on your ladder. To back out of this instruction without utilizing the **IMOVN** instruction, click the **Cancel** button.

To access on-line help, click the **Help** button.

NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure → PLC Selection** option.

**S1 + S2 NOT →
D1 + D2**



When an input is on, the values contained in operands designated by S1 and S2 are added to determine the source of data. The 16-bit word data so determined is inverted and moved to the destination, which is determined by the sum of values contained in operands designated by D1 and D2.

idec

Operands Possible (Standard Processing Mode)

Operand	S1 (Base address to move from)	S2 (Offset for S1)	D1 (Base address to move to)	D2 (Offset for D1)
I	0–35	0–35	—	0–35
Q	0–31	0–31	0–31	0–31
M	0–317	0–287	0–287	0–287
T	0–31	0–31	0–31	0–31
C	0–31	0–31	0–31	0–31
R	0–63	0–63	0–63	0–63
D (Micro ³)	0–99	0–99	0–99	0–99
D (Micro ³ C)	0–498	0–498	0–498	0–498
Constant	—	—	—	—
Repeat	1–31	—	1–31	—

NOTE: When using the high-speed processing mode, possible operands are limited.

When a timer (T) or counter (C) is designated as S1, S2, or D2, the operand data is the timer/counter current value. When T or C is designated as D1, the operand data is the timer/counter preset value which can be 0 through 9999.

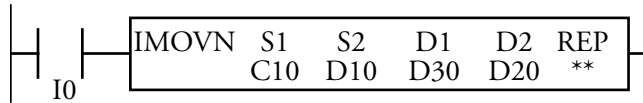


Make sure that the source data determined by S1 + S2 and the destination data determined by D1 + D2 are within the operand range. If the derived source or destination operand is out of the operand range, a user program execution error will result, turning special internal relay M304 and error indicator ERR1 on.

When a bit operand such as an input, output, internal relay, or shift register is used as the source or destination, 16 points are used. When a repeat is designated for a bit operand, the quantity of operand bits increases in 16-point increments.

Do not designate both source operand S2 and destination operand D2. (An error occurs if both are designated.) If S2 or D2 is not designated, then the source or destination operand is determined by S1 or D1 without an offset.



Example: IMOVN**C10 + D10 NOT → D30 + D20**

Source operand S1 and destination operand D1 determine the type of operand. Source operand S2 and destination operand D2 are the offset values to determine the source and destination operands.

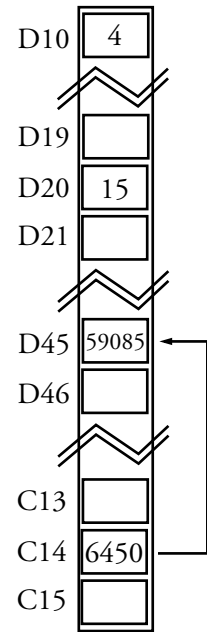
If the data of data register D10 designated by source operand S2 is 4, then the source is determined by adding the offset to counter C10 designated by source operand S1:

$$C(10 + 4) = C14$$

If data register D20 designated by destination operand D2 contains a value of 15, then the destination is determined by adding the offset to data register D30 designated by destination operand D1:

$$D(30 + 15) = D45$$

As a result, when input I0 is on, the current value of counter C14 is inverted moved to data register D45.

**Right Mouse → Advanced Instructions → Comparison**

Selecting **Advanced Instructions** → **Comparison** → accesses a sub-menu of comparison instructions: Equal To (CMP=), Not Equal To (CMP<>), Less Than (CMP<), Greater Than (CMP>), Less Than or Equal (CMP<=1), Greater Than or Equal (CMP>=1), and Double-Word Compare (CMP2).

idec

NOTE: The Double Word Compare (CMP2) instruction is only available with the Micro³C.

Data can be compared using comparison instructions such as equal to, unequal to, less than, greater than, less than or equal to, and greater than or equal to. When the comparison result is true, an output or internal relay is turned on. The repeat operation can also be used to compare more than one set of data.

Selecting **Advanced Instructions** → **Comparison** → **Equal To (CMP=)** displays the **Compare Equal To (CMP=)** dialog box.

You may also click the toolbar button:



Compare Equal To (CMP=)

Type:	S1	S2	D1	REP
<input checked="" type="radio"/> Equal To	I0000	M0000	M0020	<input type="checkbox"/>
<input type="radio"/> Not Equal To	I0000	M0000	M0020	<input type="checkbox"/>
<input type="radio"/> Less Than				<input type="checkbox"/> Repeat
<input type="radio"/> Greater Than				<input type="checkbox"/> Repeat
<input type="radio"/> Less Than or Equal				<input type="checkbox"/> Repeat
<input type="radio"/> Greater Than or Equal				
<input type="radio"/> Compare Double Word				



In the **Type:** field, click the circle of the appropriate selection.

Enter the tag name (or *nickname*) in the upper **S1** field. Then, enter the associated operand in the allocation number field below. Click the **Repeat** box below, if necessary, to indicate a repeat.

Enter the tag name (or *nickname*) in the upper **S2** field. Then, enter the associated operand in the allocation number field below. Click the **Repeat** box below, if necessary, to indicate a repeat.

The data in **S2** is compared against the data in **S1**.

Enter the tag name (or *nickname*) in the upper **D1** field. Then, enter the associated operand in the allocation number field below. Click the **Repeat** box below, if necessary, to indicate a repeat. If the selected condition is true, then this operand will turn on. If the selected condition is not true, then the operand will turn off.

Optionally, enter any associated comment in the lower tag name comment field. This reference may be a maximum of six characters per line for a maximum of four lines.

If **Repeat** is selected, enter the number of repeats in the **REP** field.

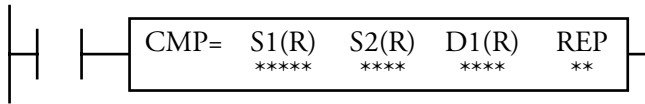
Once the dialog box is complete, click the **OK** button to display the **CMP** instruction on your ladder. To back out of this instruction without utilizing the **CMP** instruction, click the **Cancel** button.

To access on-line help, click the **Help** button.



NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure → PLC Selection** option.

S1 = S2 → D1 on



When an input is on, 16-bit word data designated by source operands S1 and S2 are compared. When S1 data is evaluated to be true to S2 data, destination operand D1 is turned on. When the condition is not met, D1 is turned off.

Operands Possible (Standard Processing Mode)

Operand	S1 (Source 1)	S2 (Source 2)	D1 (Destination 1)
I	0–35	0–35	—
Q	0–31	0–31	0–31
M	0–317	0–317	0–287
T	0–31	0–31	—
C	0–31	0–31	—
R	0–63	0–63	—
D (Micro ³)	0–99	0–99	—
D (Micro ³ C)	0–498	0–498	—

Constant	0–65535	0–65535	—
Repeat	1–31	1–31	1–31

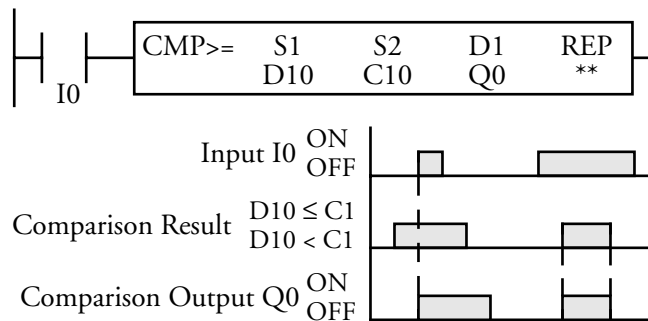
When timer (T) or counter (C) is designated as S1 or S2, the current value of the timer/counter is read out.

Maintaining the Comparison Output

If the input to the comparison instruction is off, then the comparison output is maintained. If the comparison output is on, then the on status is maintained when the input is turned off. The following examples show how the programs maintain or clear the output when the input is turned off.

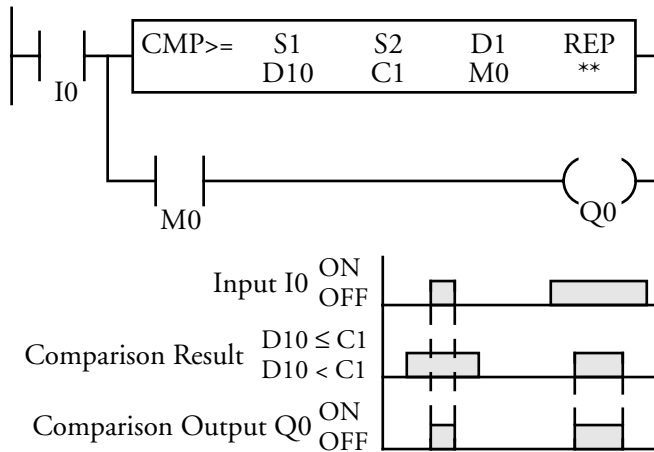
Examples: CMP>=

This program maintains the comparison output status when the input is off.

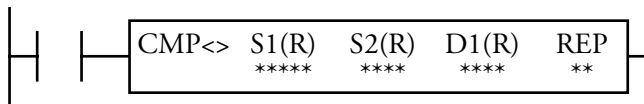


idec

This program turns the output off when the input is off.

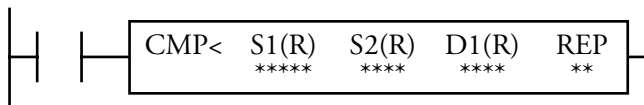


S1 ≠ S2 → D1 on

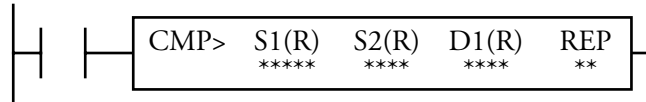


When an input is on, 16-bit word data designated by source operands S1 and S2 are compared. When S1 data is not equal to S2 data, destination operand D1 is turned on. When the condition is not met, D1 is turned off.

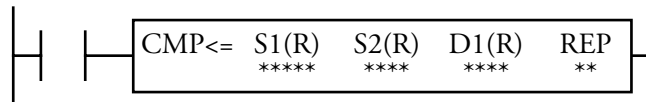
S1 < S2 → D1 on



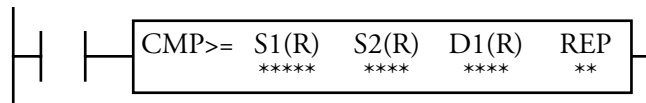
When an input is on, 16-bit word data designated by source operands S1 and S2 are compared. When S1 data is less than S2 data, destination operand D1 is turned on. When the condition is not met, D1 is turned off.

S1 > S2 → D1 on

When an input is on, 16-bit word data designated by source operands S1 and S2 are compared. When S1 data is greater than S2 data, destination operand D1 is turned on. When the condition is not met, D1 is turned off.

S1 ≤ S2 → D1 on

When an input is on, 16-bit word data designated by source operands S1 and S2 are compared. When S1 data is less than or equal to S2 data, destination operand D1 is turned on. When the condition is not met, D1 is turned off.

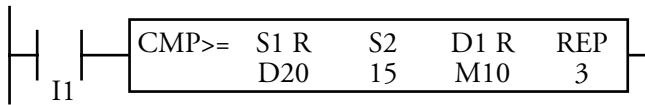
S1 ≥ S2 → D1 on

When an input is on, 16-bit word data designated by source operands S1 and S2 are compared. When S1 data is greater than or equal to S2 data, destination operand D1 is turned on. When the condition is not met, D1 is turned off.

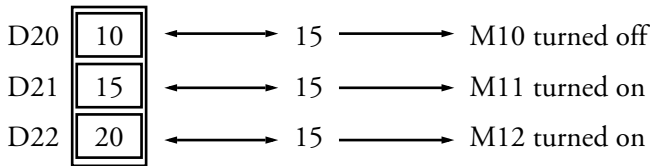
Repeat Operation in the Comparison Instructions

When S1 and/or S2 (source) is designated with a repeat, D1 (destination) is normally required to be designated with a repeat. Otherwise, only the result of the comparison in the last repeat cycle is set to one destination.

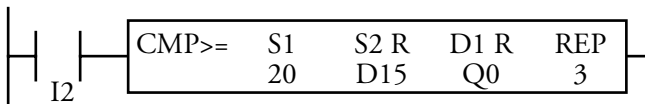
When S1 and D1 are designated with a repeat, as many operands as repeat cycles (starting with the operand designated by S1) are compared with the operand designated by S2. The comparison results are set to as many operands as repeat cycles (starting with the operand designated by D1).



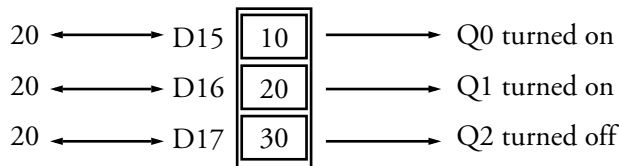
S1 (Repeat = 3) S2 (Repeat = 0) D1 (Repeat = 3)



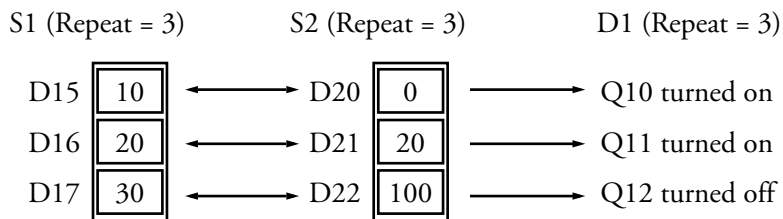
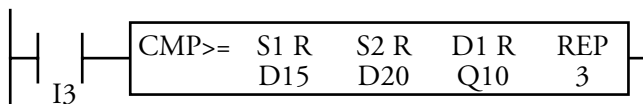
When S2 and D1 are designated with a repeat, the operand designated by S1 is compared with as many operands as repeat cycles (starting with the operand designated by S2). The comparison results are set to as many operands as repeat cycles (starting with the operand designated by D1).



S1 (Repeat = 0) S2 (Repeat = 3) D1 (Repeat = 3)



When S1, S2, and D1 are designated with a repeat, as many operands as repeat cycles (starting with the operands designated by S1 and S2) are compared with each other. The comparison results are set to as many operands as repeat cycles (starting with the operand designated by D1).



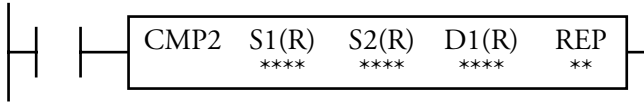
Double-Word Comparison (CMP2)

NOTE: This instruction is available with the Micro³C PLC only.

The double-word comparison (CMP2) instruction is useful to compare the data received through user communication.

The CMP2 instruction compares data in data registers. Two consecutive data registers designated by a source operand are compared with two consecutive data registers designated by another source operand. When used with a repeat designation, one CMP2 instruction can execute a maximum of 31 double-word comparison operations. With a repeat designation, the results of all double-word comparisons can be ANDed; so, the comparison results are easily determined even when comparing a large number of data.

idec

(S1)(S1+1) = (S2)(S2+1) to D1 on

When an input is on, the 32-bit data designated by source operands S1 and S1+1 is compared with the 32-bit data designated by source operands S2 and S2+1.

When (S1)(S1+1) data is equal to (S2)(S2+1) data, destination operand D1 is turned on. When the condition is not met, D1 is turned off.

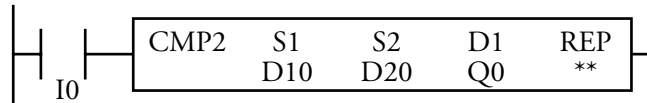
Operands Possible (Standard Processing Mode)

Operand	S1 (Source 1)	S2 (Source 2)	D1 (Destination 1)
Function	Data to compare	Data to compare	Comparison output
I	—	—	—
Q	—	—	0–31
M	—	—	0–287
T	—	—	—
C	—	—	—
R	—	—	—
D (Micro³)	0–99	0–99	—
D (Micro³C)	0–498	0–498	—
Constant	—	—	—
Repeat	1–31	1–31	1–31

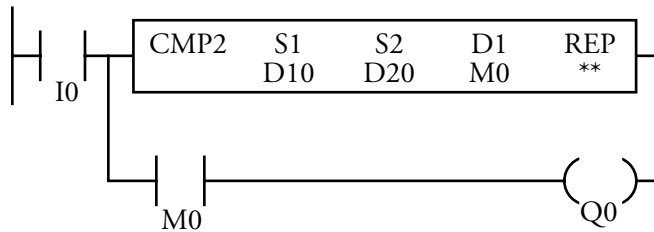
NOTE: In the high-speed processing mode, operands for advanced instructions are limited.

Examples: CMP2

The comparison output is usually maintained while the input to the comparison instruction is off. If the comparison output is on, the on status is maintained when the input is turned off as demonstrated by this program.



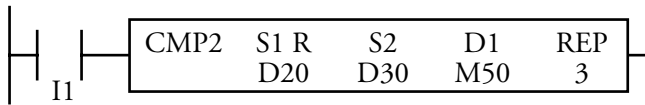
This program turns the output off when the input is off.



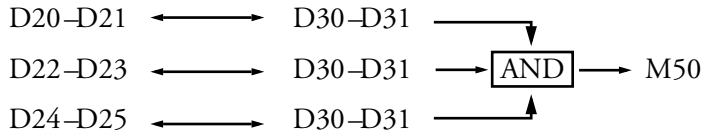
Repeat Operation in the Double-Word Comparison Instruction

Unlike other advanced instructions, when S1 and/or S2 (source) is designated with a repeat and when D1 (destination) is not designated with a repeat, then the comparison results are ANDed and set to one destination.

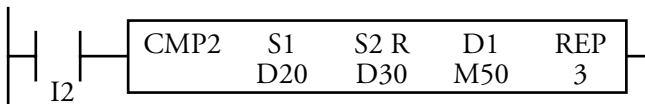
When only S1 (source) is designated with a repeat, as many double-word operands as repeat cycles (starting with the operand designated by S1) are compared with the double-word operand designated by S2. The comparison results are ANDed and set to the operand designated by D1.



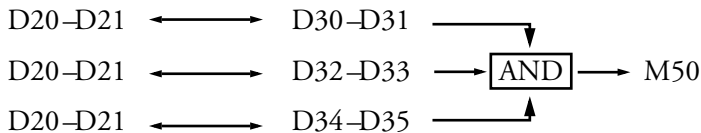
S1 (Repeat = 3) S2 (Repeat = 0) D1 (Repeat = 0)



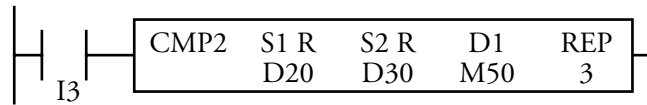
When only S2 (source) is designated with a repeat, the double-word operand designated by S1 is compared with as many double-word operands as repeat cycles, starting with the operand designated by S2. The comparison results are ANDed and set to the operand designated by D1.



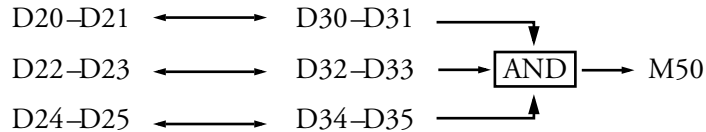
S1 (Repeat = 0) S2 (Repeat = 3) D1 (Repeat = 0)



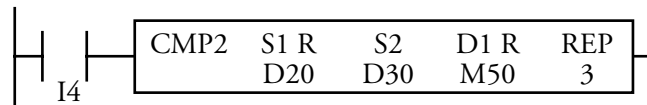
When S1 (source) and S2 (source) are designated with repeats, as many double-word operands as repeat cycles, starting with the operands designated by S1 and S2, are compared with each other. The comparison results are ANDed and set to the operand designated by D1.



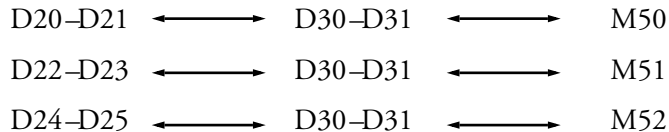
S1 (Repeat = 3) S2 (Repeat = 3) D1 (Repeat = 0)



When S1 (source) and D1 (destination) are designated with repeats, as many double-word operands as repeat cycles (starting with the operand designated by S1) are compared with the double-word operand designated by S2. The comparison results are set to as many operands as repeat cycles, starting with the operand designated by D1.

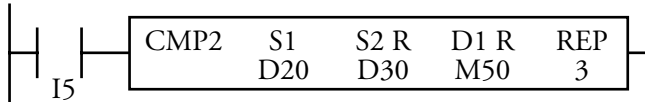


S1 (Repeat = 3) S2 (Repeat = 0) D1 (Repeat = 3)

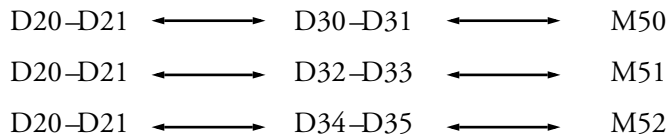


idec

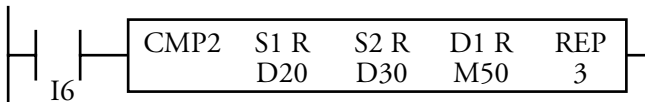
When S2 (source) and D1 (destination) are designated with repeats, the double-word operand designated by S1 is compared with as many double-word operands as repeat cycles, starting with the operand designated by S2. The comparison results are set to as many operands as repeat cycles, starting with the operand designated by D1.



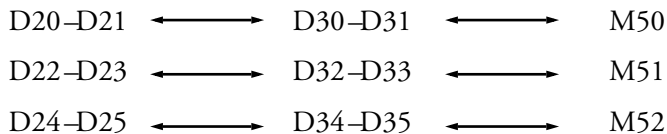
S1 (Repeat = 0) S2 (Repeat = 3) D1 (Repeat = 3)



When S1, S2 (source), and D1 (destination) are designated with repeat, double-word operands as many as the repeat cycles (starting with the operands designated by S1 and S2) are compared with each other. The comparison results are set to operands as many as the repeat cycles starting with the operand designated by D1.



S1 (Repeat = 3) S2 (Repeat = 3) D1 (Repeat = 3)




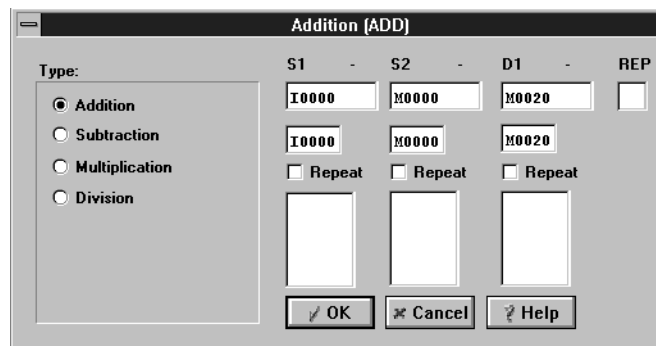
Right Mouse → Advanced Instructions → Binary Arithmetic

Selecting **Advanced Instructions → Binary Arithmetic →** accesses a sub-menu of instructions: Addition (ADD), Subtraction (SUB), Multiplication (MUL), and Division (DIV).

Binary arithmetic instructions make it possible for the user to program computations using addition, subtraction, multiplication, and division. For addition and subtraction operands, internal relay M303 is used as the carry or borrow flag.

Selecting **Advanced Instructions → Binary Arithmetic → Addition (ADD)** displays the **Addition (ADD)** dialog box.

You may also click the toolbar button: 



Type:	S1	S2	D1	REP
<input checked="" type="radio"/> Addition	I0000	M0000	M0020	<input type="checkbox"/>
<input type="radio"/> Subtraction	I0000	M0000	M0020	<input type="checkbox"/>
<input type="radio"/> Multiplication	<input type="checkbox"/> Repeat	<input type="checkbox"/> Repeat	<input type="checkbox"/> Repeat	
<input type="radio"/> Division				



In the **Type:** field, click the circle of the appropriate selection.

Enter the tag name (or *nickname*) in the upper **S1** field. Then, enter the associated operand in the allocation number field below. Click the **Repeat** box below, if necessary, to indicate a repeat.

idec

Enter the tag name (or *nickname*) in the upper S2 field. Then, enter the associated operand in the allocation number field below. Click the **Repeat** box below, if necessary, to indicate a repeat.

The data in S1 and S2 is added, subtracted, multiplied, or divided as specified in the **Type:** field.

Enter the tag name (or *nickname*) in the upper D1 field. Then, enter the associated operand in the allocation number field below. Click the **Repeat** box below, if necessary, to indicate a repeat. The result of the arithmetic is set to operand D1.

Optionally, enter any associated comment in the lower tag name comment field. This reference may be a maximum of six characters per line for a maximum of four lines.

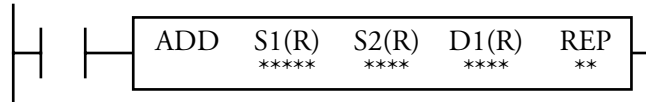
If **Repeat** is selected, enter the number of repeats in the **REP** field.

Once the dialog box is complete, click the **OK** button to display the arithmetic instruction on your ladder. To back out of this instruction without utilizing the arithmetic instruction, click the **Cancel** button.

To access on-line help, click the **Help** button.

NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure → PLC Selection** option.



S1 + S2 → D1, CY

When an input is on, 16-bit word data designated by source operands S1 and S2 are added. The result is set to destination operand D1 and carry (M303).

Operands Possible (Standard Processing Mode)

Operand	S1 (Source 1)	S2 (Source 2)	D1 (Destination 1)
I	0-35	0-35	—
Q	0-31	0-31	0-31
M	0-317	0-317	0-287
T	0-31	0-31	0-31
C	0-31	0-31	0-31
R	0-63	0-63	0-63
D (Micro ³)	0-99	0-99	0-99
D (Micro ³ C)	0-498	0-498	0-498
Constant	0-65535	0-65535	—
Repeat	1-31	1-31	1-31



When a timer (T) or counter (C) is used as S1 or S2, the current value of the timer/counter is read out.

When T or C is used as D1, the data is written in as a preset value which can be 0–9999.

NOTE: When using the timer or counter as a destination, make sure that the data does not exceed the maximum preset value of 9999. When the preset value exceeds 9999, a user program execution error will result, turning on error indicator ERR1 and special internal relay M304. When a user program execution error occurs, the result is not set to the destination.

Since the binary arithmetic instructions are executed in each scan while input is on, a pulse input from a SOTU or SOTD instruction should be used as required.

Using Carry or Borrow Flags

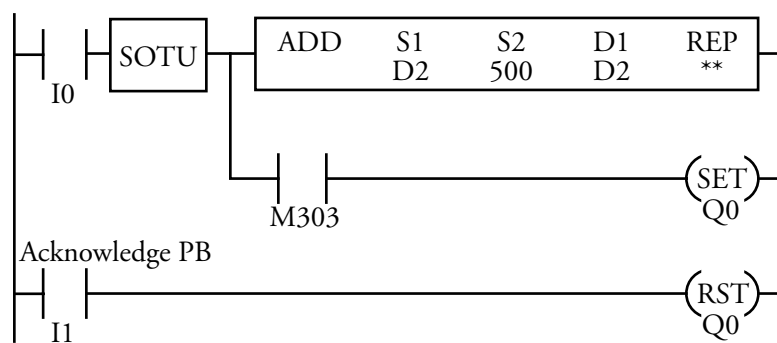
When the D1 (destination) data exceeds 65535 as a result of addition, a carry occurs and special internal relay M303 is turned on. When the D1 data is less than zero as a result of subtraction, a borrow occurs and special internal relay M303 is turned on.

There are three ways to program the carrying process (see examples below). If a carry never goes on, then the program does not have to include internal relay M303 to process carrying. If a carry goes on unexpectedly, then an output can be programmed to be set as a warning indicator. If a carry goes on expectedly, then the number of times a carry occurs can be added and used as one word data in a specified register.



Example: ADD

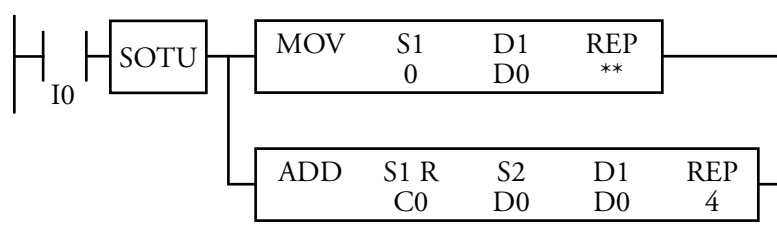
This example demonstrates the use of a carry flag from special internal relay M303 to set an alarm signal.

**D2 + 500 → D2**

When a carry occurs, output Q0 is set as a warning indicator. When the acknowledge PB (I1) is pressed, the warning indicator is reset.

Example: Repeat Operation Using ADD

This example demonstrates the use of the repeat operation to total the current values of four counters using the ADD instruction.



When input I0 is turned on, the move (MOV) instruction sets 0 to data register D0. If the current values of counters C0–C10 are 10, 20, 30, and 40 (respectively), then the ADD instruction with four repeat cycles totals the current value as follows:

$$C0 (10) + D0 (0) \rightarrow D0(10)$$

$$C1 (20) + D0 (10) \rightarrow D0(30)$$

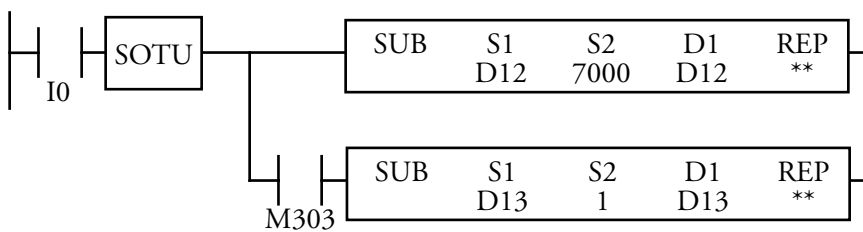
$$C2 (30) + D0 (30) \rightarrow D0(60)$$

$$C3 (40) + D0 (60) \rightarrow D0(100)$$

Data register D0 stores the final result of 100.

Example: SUB

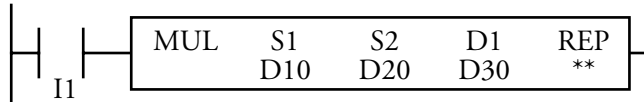
This example demonstrates the use special internal relay M303 to process a borrow flag.



D12 - 7000 → D12

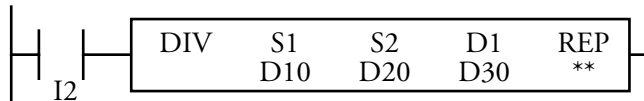
Process borrowing so that the number of times a borrow occurs is subtracted from D13. When a borrow occurs, D13 is decremented by one.

idec

Example: MUL**D10 x D20 → D30**

When input I1 is on, the data of D10 is multiplied by the data of D20. The result is set to D30.

NOTE: When the result exceeds 65535, special internal relay M304 (program execution error) is turned on and error indicator ERR1 is lit.

Example: DIV**D10 ÷ D20 → D30 (quotient), D31 (remainder)**

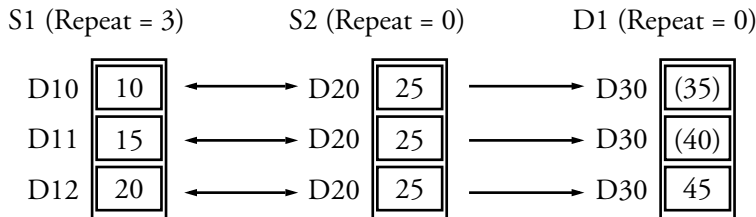
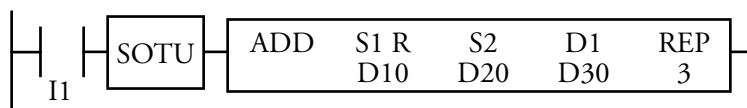
When input I2 is on, data of D10 is divided by data of D20. The quotient is set to D30, and the remainder is set to D31.

NOTE: The destination uses two word operands; so, do not use data register D99 as destination operand D1. Otherwise, a user program syntax error occurs, and error indicator ERR1 is lit. When using a bit operand such as an internal relay for the destination, 32 internal relays are required; so, do not use internal relay M251 or a larger number as destination operand D1.

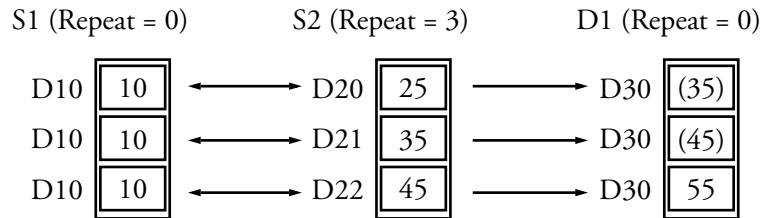
Repeat Operation in the ADD, SUB, and MUL Instructions

Source operands S1 and S2 and destination operand D1 can be designated with repeats, individually or in combination. When destination operand D1 is not designated with a repeat, the final result is set to destination operand D1. When a repeat is designated, as many consecutive operands as repeat cycles (starting with the designated operand) are used. Since the repeat operation works similarly on the addition (ADD), subtraction (SUB), and multiplication (MUL) instructions, the following examples are described using the ADD instruction.

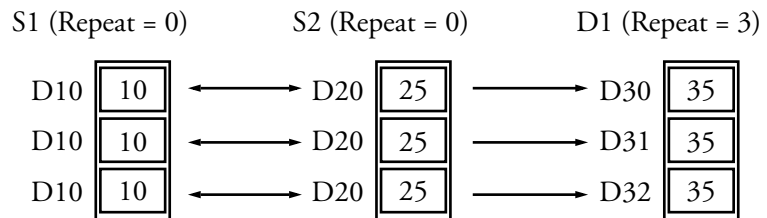
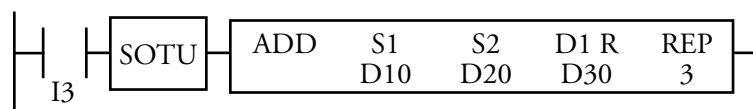
When only S1 (source) is designated with a repeat, the final result is set to destination operand D1.



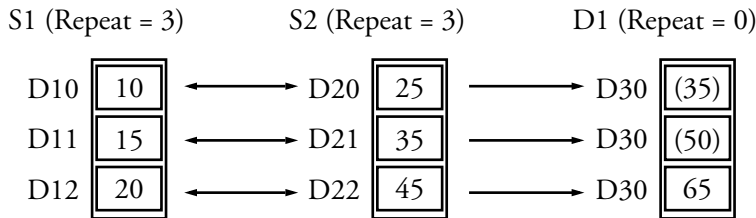
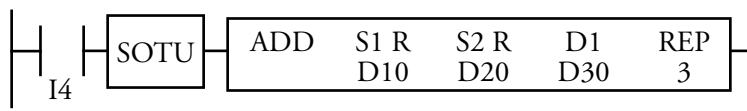
When only S2 (source) is designated with a repeat, the final result is set to destination operand D1.



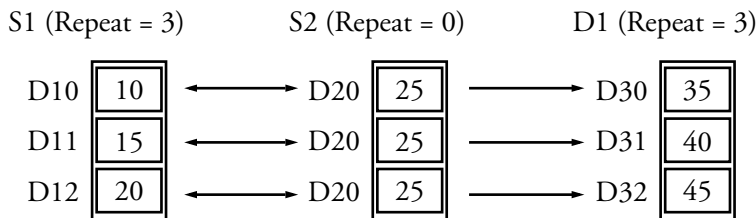
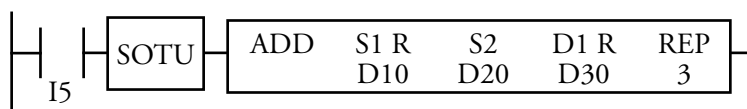
When only D1 (destination) is designated with a repeat, the same result is set to the three operands starting with D1.



When S1 and S2 (source) are designated with a repeat, the final result is set to destination operand D1.



When S1 (source) and D1 (destination) are designated with a repeat, different results are set to the three operands starting with D1.



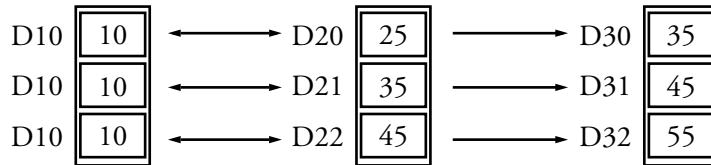
When S2 (source) and D1 (destination) are designated with a repeat, different results are set to the three operands starting with D1.



S1 (Repeat = 0)

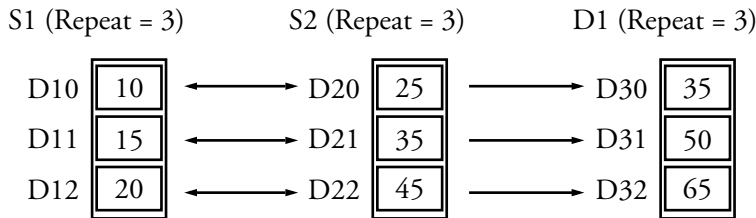
S2 (Repeat = 3)

D1 (Repeat = 3)



idec

When all operands are designated with a repeat, different results are set to the three operands starting with D1.



NOTE: Special internal relay M308 (carry/borrow) is turned on when a carry or borrow occurs in the last operation. When an error occurs in any operation, special internal relay M304 (user program execution error) and error indicator ERR1 are turned on and maintained while operation is continued.

Right Mouse → ***Advanced Instructions*** → ***Boolean Computation***

Selecting **Advanced Instructions** → **Boolean Computation** → accesses a sub-menu of instructions: And Word (ANDW), OR Word (ORW), and Exclusive OR Word (XORW).

Boolean computations use the AND, OR, and exclusive OR statements as carried out by the ANDW, ORW, and XORW instructions, respectively.



Selecting **Advanced Instructions** → **Boolean Computation** → **And Word** (ANDW) displays the **And Word (ANDW)** dialog box.

You may also click the toolbar button:



Type:	S1	S2	D1	REP
<input checked="" type="radio"/> And Word	I0000	M0000	M0020	<input type="checkbox"/>
<input type="radio"/> OR Word	I0000	M0000	M0020	<input type="checkbox"/>
<input type="radio"/> Exclusive OR Word				<input type="checkbox"/>
	<input type="checkbox"/> Repeat	<input type="checkbox"/> Repeat	<input type="checkbox"/> Repeat	
	<input type="button" value="OK"/>	<input type="button" value="Cancel"/>	<input type="button" value="Help"/>	



In the **Type:** field, click the circle of the appropriate selection.

Enter the tag name (or *nickname*) in the upper **S1** field. Then, enter the associated operand in the allocation number field below. Click the **Repeat** box below, if necessary, to indicate a repeat.

Enter the tag name (or *nickname*) in the upper **S2** field. Then, enter the associated operand in the allocation number field below. Click the **Repeat** box below, if necessary, to indicate a repeat.

The data in **S1** and **S2** is ANDed, ORed, or exclusively ORed as specified in the **Type:** field.

idec

Enter the tag name (or *nickname*) in the upper D1 field. Then, enter the associated operand in the allocation number field below. Click the **Repeat** box below, if necessary, to indicate a repeat. The result of the Boolean computation is set to operand D1.

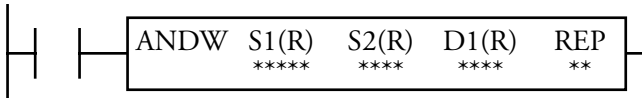
Optionally, enter any associated comment in the tag name comment field. This reference may be a maximum of six characters per line for a maximum of four lines.

If **Repeat** is selected, enter the number of repeats in the **REP** field.

Once the dialog box is complete, click the **OK** button to display the Boolean instruction on your ladder. To back out of this instruction without utilizing the Boolean instruction, click the **Cancel** button.

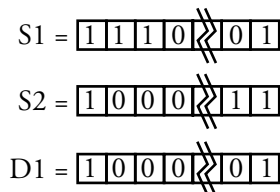
To access on-line help, click the **Help** button.

And Word (ANDW)

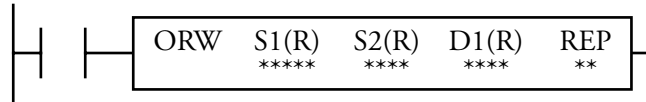


S1 • S2 → D1

When an input is on, 16-bit word data designated by source operands S1 and S2 are ANDed, bit by bit. The result is set to destination operand D1.



S1	S2	D1
0	0	0
0	1	0
1	0	0
1	1	1

OR Word (ORW)

S1 =

1	1	1	0	0	1
---	---	---	---	---	---

S2 =

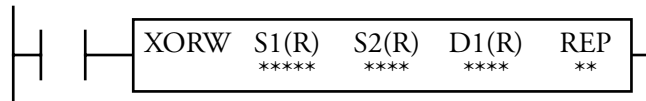
1	0	0	0	1	1
---	---	---	---	---	---

D1 =

1	1	1	0	1	1
---	---	---	---	---	---

S1 • S2 → D1

When an input is on, 16-bit word data designated by source operands S1 and S2 are ORed, bit by bit. The result is set to destination operand D1.

Exclusive OR Word (XORW)

S1 =

1	1	1	0	0	1
---	---	---	---	---	---

S2 =

1	0	0	0	1	1
---	---	---	---	---	---

D1 =

0	1	1	0	1	0
---	---	---	---	---	---

S1 • S2 → D1

When an input is on, 16-bit word data designated by source operands S1 and S2 are exclusively ORed, bit by bit. The result is set to destination operand D1.

idec

Operands Possible (Standard Processing Mode)

Operand	S1 (Source 1)	S2 (Source 2)	D1 (Destination 1)
Function	Data for computation	Data for computation	Destination to store results
I	0-35	0-35	—
Q	0-31	0-31	0-31
M	0-317	0-317	0-287
T	0-31	0-31	0-31
C	0-31	0-31	0-31
R	0-63	0-63	0-63
D (Micro³)	0-99	0-99	0-99
D (Micro³C)	0-498	0-498	0-498
Constant	0-65535	0-65535	—
Repeat	1-31	1-31	1-31

When timer (T) or counter (C) is used as S1 or S2, the current value of the timer/counter is read out.

When T or C is used as D1, the data is written in as a preset value which can be 0 through 9999.



NOTE: When using the timer or counter as a destination, make sure that the data does not exceed the maximum preset value of 9999. When the preset value exceeds 9999, a user program execution error will result, turning on special internal relay M304. The ERR1 indicator on the Micro³ or Micro³C base unit will also be turned on.

Since these Boolean instructions are executed in each scan while an input is on, a pulse input from an SOTU or SOTD instruction should be used as required.

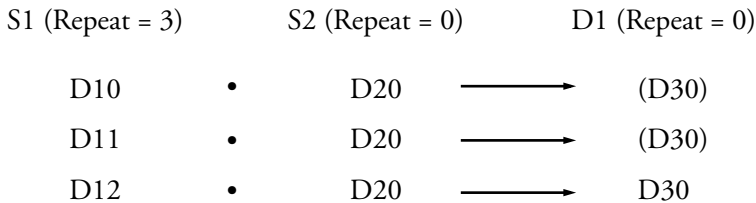
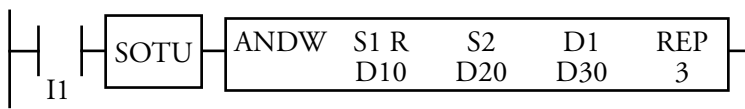
Repeat Operation in the ANDW, ORW, and XORW Instructions

Source operands S1 and S2 and destination operand D1 can be designated with repeats individually or in combination. When destination operand D1 is not designated with a repeat, the final result is set to destination operand D1. When a repeat is designated, as many consecutive operands as repeat cycles (starting with the designated operand) are used.

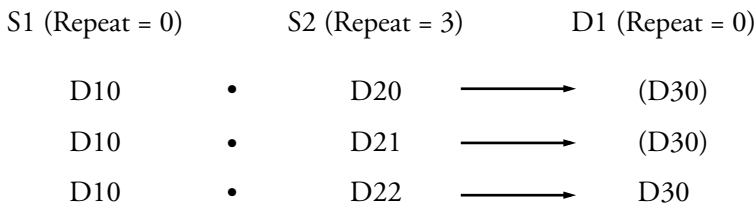
Since the repeat operation works similarly on the AND Word (ANDW), OR Word (ORW), and Exclusive OR Word (XORW) instructions, the following examples are described using the ANDW instruction.



When only S1 (source) is designated with a repeat, the final result is set to destination operand D1.



When only S2 (source) is designated with a repeat, the final result is set to destination operand D1.



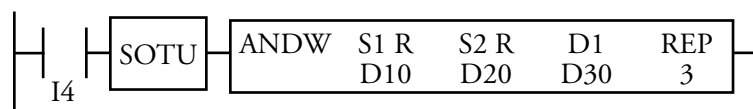
When only D1 (destination) is designated with a repeat, the same result is set to the three operands starting with D1 (destination).



S1 (Repeat = 0) S2 (Repeat = 0) D1 (Repeat = 3)

D10	•	D20	→	D30
D10	•	D20	→	D31
D10	•	D20	→	D32

When S1 and S2 (source) are designated with repeats, the final result is set to destination operand D1.

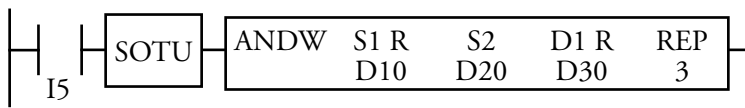


S1 (Repeat = 3) S2 (Repeat = 3) D1 (Repeat = 0)

D10	•	D20	→	(D30)
D11	•	D21	→	(D30)
D12	•	D22	→	D30

idec

When S1 (source) and D1 (destination) are designated with repeats, different results are set to the three operands starting with D1.



S1 (Repeat = 3) S2 (Repeat = 0) D1 (Repeat = 3)

D10	•	D20	→	D30
D11	•	D20	→	D31
D12	•	D20	→	D32

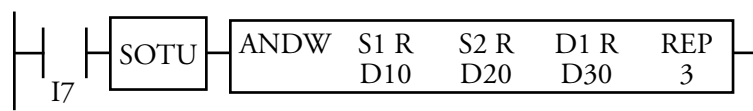
When S2 (source) and D1 (destination) are designated with repeats, different results are set to the three operands starting with D1.



S1 (Repeat = 0) S2 (Repeat = 3) D1 (Repeat = 3)

D10	•	D20	→	D30
D10	•	D21	→	D31
D10	•	D22	→	D32

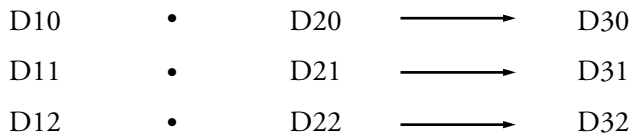
When all operands are designated with repeats, different results are set to the three operands starting with D1.



S1 (Repeat = 3)

S2 (Repeat = 3)

D1 (Repeat = 3)



***Right Mouse* → Advanced Instructions → Bit Shift and Rotate**

Selecting **Advanced Instructions** → **Bit Shift and Rotate** → accesses a sub-menu of instructions: Shift Left (SFTL), Shift Right (SFTR), Rotate Left (ROTL), and Rotate Right (ROTR).

Bit shift and rotate instructions are used to shift the 16-bit data in the data register designated by source operand S1 to the left or right by the quantity of bits designated. The result is set to the data register designated by source operand S1 and a carry (special internal relay M303). Since the bit shift and rotate instructions are executed in each scan while the input is on, a level input or pulse input should be used as required.

idec

Selecting **Advanced Instructions** → **Bit Shift and Rotate** → **Shift Left (SFTL)** displays the **Shift Left (SFTL)** dialog box.

You may also click the toolbar button:




In the **Type:** field, click the circle of the appropriate selection.

Enter the tag name (or *nickname*) in the **S1/Tag Name:** field. Then, enter the associated operand in the **Allocation Number:** field below.

The data in S1 is shifted to the left, shifted to the right, rotated to the left, or rotated to the right as specified in the **Type:** field.

Enter the number of bits to shift or rotate in the **bit** field. This is the number of bits of shift or rotate which will occur to the operand in S1.

Finally, optionally enter any associated comment in the **Tag Name Comment:** field. This reference may be a maximum of six characters per line for a maximum of four lines.

Once the dialog box is complete, click the **OK** button to shift or rotate the instruction on your ladder. To back out of this instruction without utilizing the shift or rotate instruction, click the **Cancel** button.

To access on-line help, click the **Help** button.

NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure** → **PLC Selection** option.

Shift Left (SFTL)

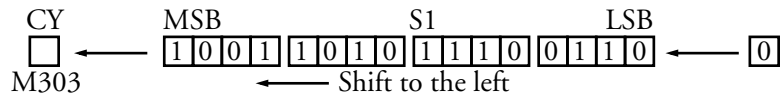


CY ← S1

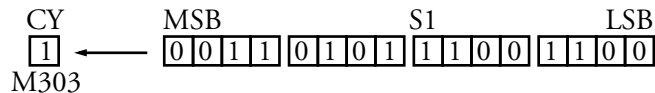
When an input is on, the 16-bit data of the data register designated by source operand S1 is shifted to the left by the quantity of bits designated by operand bit. The result is set to the data register. The last bit status shifted out is set to a carry (special internal relay M303). Zeros are set to the least significant bit (LSB).

When bit to shift = 1

Before shift:

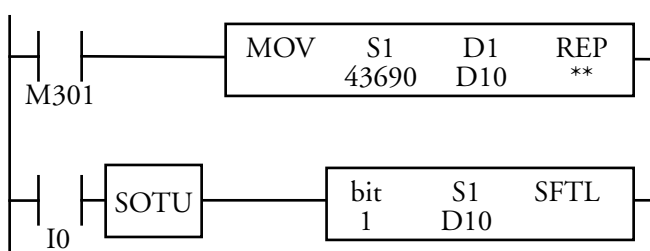


After shift:



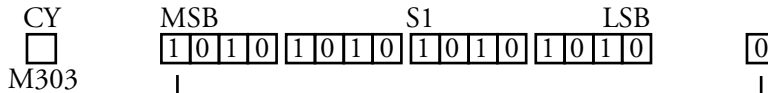
idec

Example: SFTL

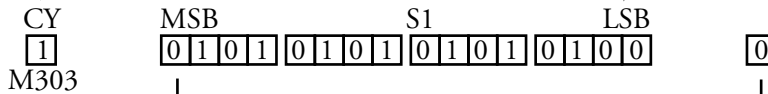


Bits to shift = 1

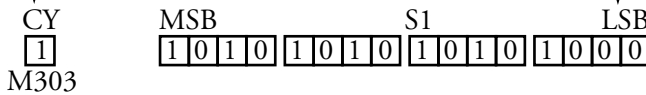
Before shift: D10 = 43690



After first shift: D10 = 21844



After second shift: D10 = 43688

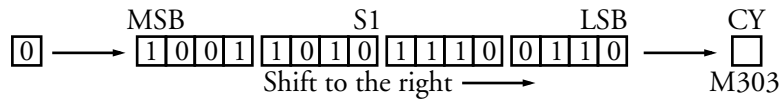


Shift Right (SFTR)**S1 → CY**

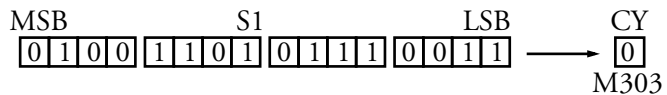
When an input is on, the 16-bit data of the data register designated by source operand S1 is shifted to the right by the quantity of bits designated by operand bit. The result is set to the data register. The last bit status shifted out is set to a carry (special internal relay M303). Zeros are set to the most significant bit (MSB).

When bit to shift = 1

Before shift:



After shift:

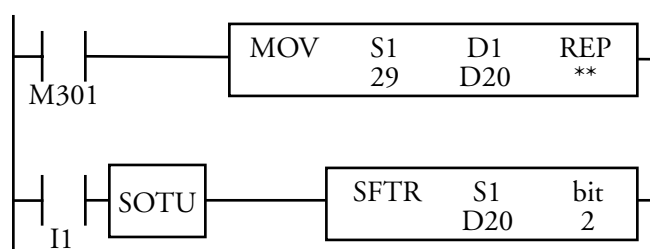


Operands Possible (Standard Processing Mode)

Operand	S1 (Source 1)	Bit
Function	Data for bit shift	Quantity of bits to shift
I	—	—
Q	—	—
M	—	—
T	—	—
C	—	—
R	—	—
D (Micro³)	0–99	—
D (Micro³C)	0–498	—
Constant	—	0–15
Repeat	—	—

Since the bit shift instructions are executed in each scan while the input is on, a pulse input from an SOTU or SOTD instruction should be used as required.



Example: SFTR

M301 is the initialize pulse special internal relay. When the Micro³ or Micro³C starts operation, the move (MOV) instruction sets 29 to data register D20.

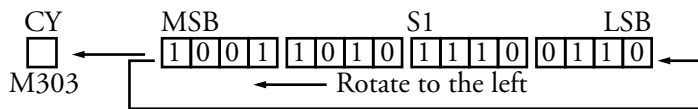
Each time input I1 is turned on, the 16-bit data of data register D20 is shifted to the right by two bits as designated by operand bit. The last bit status shifted out is set to a carry (special internal relay M303). Zeros are set to the most significant bit (MSB).

Rotate Left (ROTL)

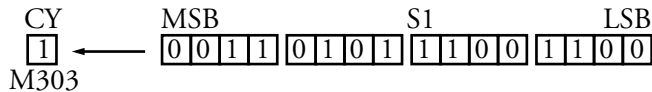
When an input is on, the 16-bit data of the data register designated by S1 is rotated to the left by the quantity of bits designated by operand bit. The last bit status rotated out of the data register is set to a carry (special internal relay M303).

When bit to rotate = 1

Before rotation:



After rotation:



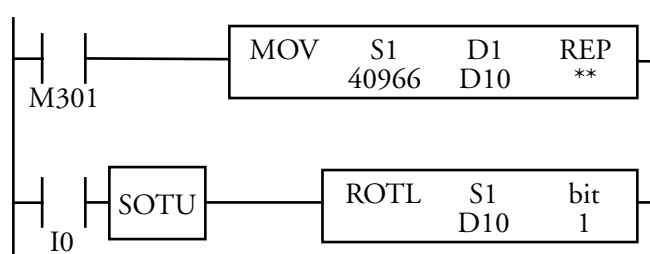
Operands Possible (Standard Processing Mode)

Operand	S1 (Source 1)	Bit
Function	Data for bit rotation	Quantity of bits to rotate
I	—	—
Q	—	—
M	—	—
T	—	—
C	—	—

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R	—	—
D (Micro³)	0–99	—
D (Micro³C)	0–498	—
Constant	—	0–15
Repeat	—	—

Since the bit rotate instructions are executed in each scan while an input is on, a pulse input from an SOTU or SOTD instruction should be used as required.



M301 is the initialize pulse special internal relay. When the Micro³ or Micro³C starts operation, the move (MOV) instruction sets 40966 to data register D10.

Each time input I0 is turned on, 16-bit data of data register D10 is rotated to the left by one bit as designated by the operand bit. The status of the most significant bit (MSB) is set to a carry (special internal relay M303).

Rotate Right (ROTR)

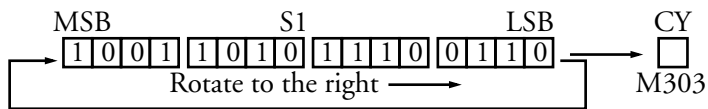
idec



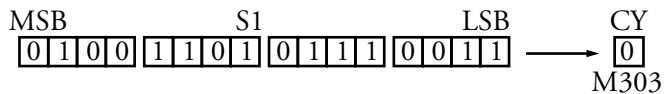
When an input is on, the 16-bit data of the data register designated by S1 is rotated to the right by the quantity of bits designated by operand bit. The last bit status rotated out of the data register is set to a carry (special internal relay M303).

When bit to rotate = 1

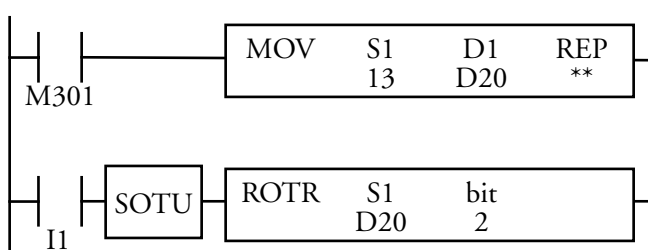
Before rotation:



After rotation:



Example: ROTR



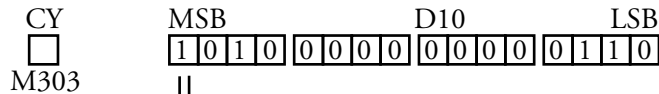
M301 is the initialize pulse special internal relay. When the Micro³ or Micro³C starts operation, the move (MOV) instruction sets 13 to data register D20.

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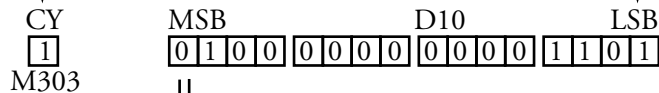
Each time input I1 is turned on, 16-bit data of data register D20 is rotated to the right by one bit as designated by the operand bit. The last bit status rotated out of the data register is set to a carry (special internal relay M303).

Bits to shift = 1

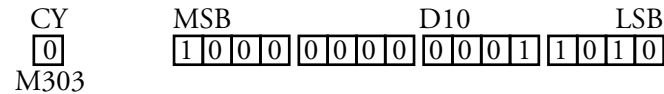
Before rotation: D10 = 40966



After first rotation: D10 = 16397



After second rotation: D10 = 32794



***Right Mouse* → Advanced Instructions → Real-time Clock/Calendar**

Selecting **Advanced Instructions** → **Real-time Clock/Calendar** → accesses a sub-menu of instructions: Calendar Read (CALR), Calendar Write (CALW), Clock Read (CLKR), Clock Write (CLKW), and Adjust (ADJ).


The 16- and 24-point type Micro³ and Micro³C base units feature five real-time calendar and clock instructions used for programming the calendar and clock.

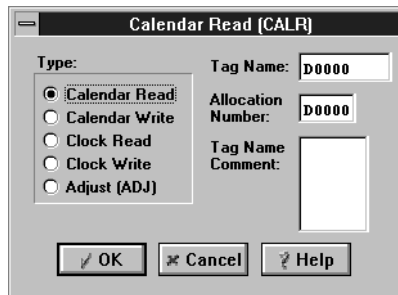
These instructions cannot be used on the 10-point type base unit. After the initial



setting of the calendar and clock using FUN28, the date and time are maintained. If control data registers D95 through D98 are enabled using FUN10, the day of week, hour, minute, and second data can be read out to these data registers when the Micro³ or Micro³C base unit is running or stopped.

Selecting **Advanced Instructions** → **Real-time Clock/Calendar** → **Calendar Read (CALR)** displays the **Calendar Read (CALR)** dialog box.

You may also click the toolbar button: 





In the **Type:** field, click the circle of the appropriate selection.

Enter the appropriate tag name (or *nickname*) in the **Tag Name:** field.

Then, enter the associated operand in the **Allocation Number:** field below. The clock or calendar data is read to four data registers beginning with this one.

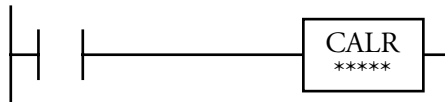
Finally, optionally enter any associated comment in the **Tag Name Comment:** field. This reference may be a maximum of six characters per line for a maximum of four lines.

Once the dialog box is complete, click the **OK** button to activate the clock/calendar instruction on your ladder. To back out of this instruction without utilizing the clock/calendar instruction, click the **Cancel** button.

To access on-line help, click the **Help** button.

NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure → PLC Selection** option.

Calendar Read (CALR)



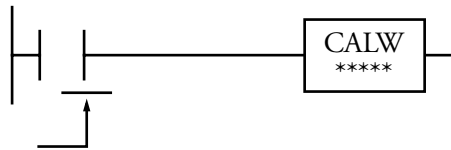
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When an input is on, calendar data (year, month, day, and day of week) is read to four data registers starting with the designated operand.

D =	Year (0 to 99)
D+1 =	Month (1 to 12)
D+2 =	Day (1 to 31)
D+3 =	Day of week (0 to 6) assigned as follows:

0	Sunday
1	Monday
2	Tuesday
3	Wednesday
4	Thursday
5	Friday
6	Saturday

Calendar Write (CALW)



When an input is turned on, the calendar is set using data stored in four data registers starting with the designated operand.

D =	Year (0 to 99)
D+1 =	Month (1 to 12)
D+2 =	Day (1 to 31)
D+3 =	Day of week (0 to 6) assigned as follows:

0	Sunday
1	Monday
2	Tuesday
3	Wednesday
4	Thursday
5	Friday
6	Saturday



NOTE: Only the months of January, March, May, July, August, October, and December can be programmed with a date of the 31st. The month of February can be programmed with a date of the 29th only for actual leap years. (Leap years are automatically adjusted).

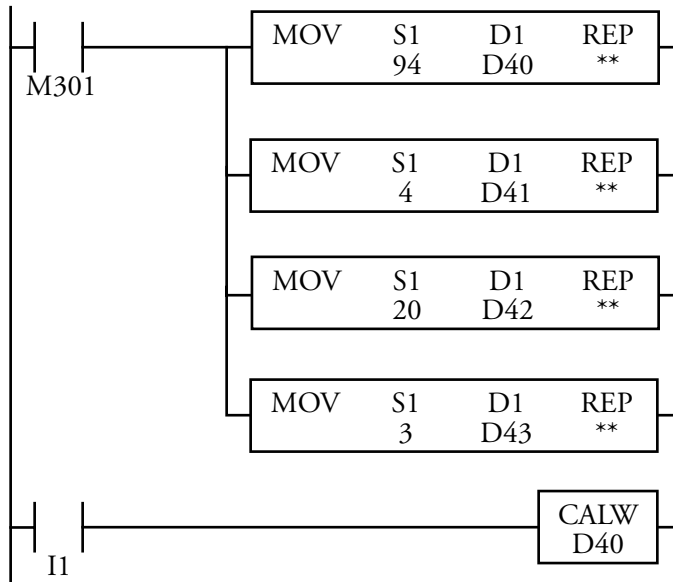
NOTE: If the month, day, or day of the week is assigned a value which is not within the range specified above or if a date is not assigned according to the preceding note, then invalid data will result in a user program execution error. Internal relay M304 turns on, and the ERR1 indicator on the Micro³ or Micro³C base unit also turns on. The error code is stored in data register D93 when the control data register is enabled using FUN10.

Operands Possible (Standard Processing Mode)

Function	Source to write the calendar data
Operand: D	0 – 99 for Micro ³ ; 0 – 498 for Micro ³ C

Since the CALW instruction is executed at the rising edge of the input, a pulse input from an SOTU or SOTD instruction is not required.



Example: CALW

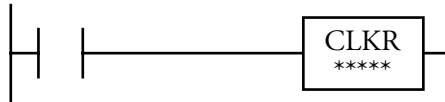
M301 is the initialize pulse special internal relay. When the Micro³ or Micro³C starts operation, the MOV instructions set calendar data to data registers D40 through D43.

D40 =	94 (Year 1994)
D41 =	4 (April)
D42 =	20 (Day)
D43 =	3 (Wednesday)

When input I1 is turned on, the calendar is set using data from data registers D40 through D43.

NOTE: Calendar data can also be set using FUN28.

Clock Read (CLKR)



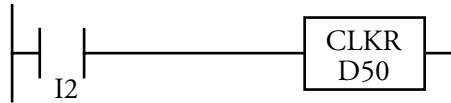
When an input is on, clock data (hour, minute, and second) is read to three data registers starting with the designated operand.

D =	Hour (0 to 23)
D+1 =	Minute (0 to 59)
D+2 =	Second (0 to 59)

Operands Possible

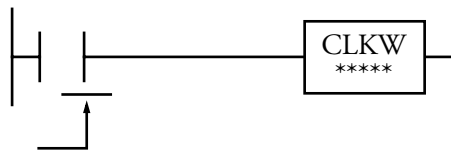
Function	Destination to read the clock data
Operand: D	0–99 for Micro ³ ; 0–498 for Micro ³ C



Example: CLKR

When input I2 is on, clock data is read to data registers D50 through D52.

D50 =	Hour (0 to 23)
D51 =	Minute (0 to 59)
D52 =	Second (0 to 59)

Clock Write (CLKW)

When an input is turned on, the clock is set using the data stored in three data registers starting with the designated operand.

D =	Hour (0 to 23)
D+1 =	Minute (0 to 59)
D+2 =	Second (0 to 59)

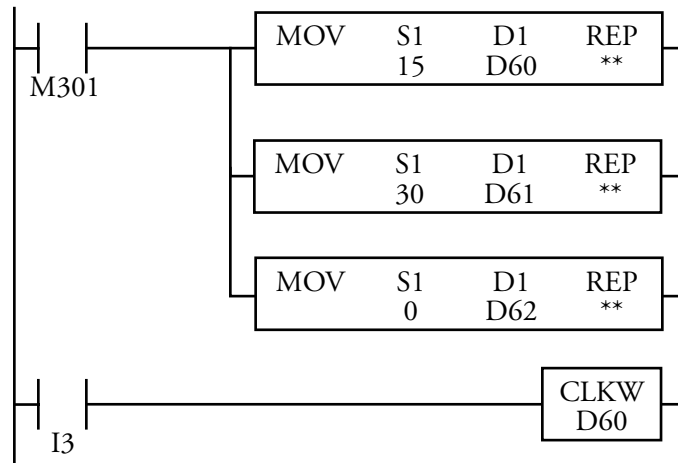
NOTE: If time is assigned a value which is not within the range specified above, invalid data will result in a user program execution error. Internal relay M304 turns on, and the ERR1 indicator on the Micro³ or Micro³C base unit also turns on. The error code is stored in data register D93 when the control data register is enabled using FUN10.

Operands Possible

Function	Source to write the clock data
Operand: D	0–99 for Micro ³ ; 0–498 for Micro ³ C

Since the CLKW instruction is executed at the rising edge of the input, a pulse input from an SOTU or SOTD instruction is not required.

Example: CLKW



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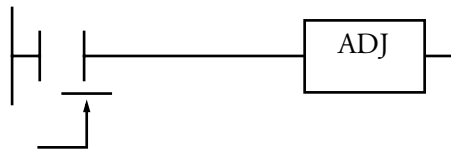
M301 is the initialize pulse special internal relay. When the Micro³ or Micro³C starts operation, the MOV instructions set clock data to data registers D60 through D62.

D60 =	Hour (15)
D61 =	Minute (30)
D62 =	Second (0)

When input I3 is turned on, the clock is set using data from data registers D60 through D62.

NOTE: Clock data can also be set using FUN28.

Adjust (ADJ)

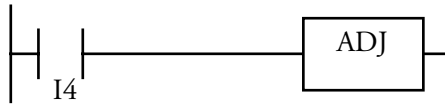


The Adjust (ADJ) instruction synchronizes the Micro³ or Micro³C internal clock with another established clock for precise timing.

When an input is turned on, the clock is adjusted with respect to seconds. If seconds are between 0 and 29 for the current time, the adjustment for seconds will be set to 0 and minutes remain the same. If seconds are between 30 and 59 for the current time, the adjustment for seconds will be set to 0 and minutes are incremented by one. The ADJ instruction is useful for precise timing which starts at zero seconds.

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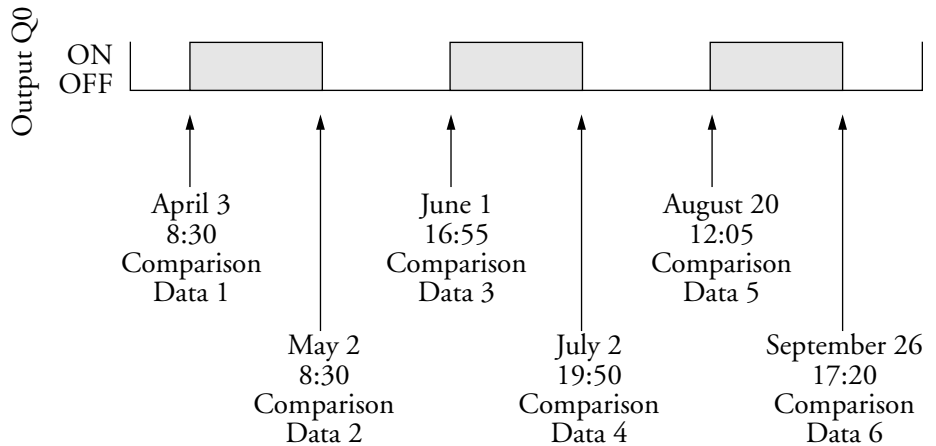
Since the ADJ instruction is executed at the rising edge of the input, a pulse input from an SOTU or SOTD instruction is not required.



When input I4 is turned on, the clock is adjusted with respect to seconds.

ADJ Example: Time Scheduled Control

This example demonstrates a program to turn output Q0 on and off according to the chart below:



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Internal relays are allocated as shown below.

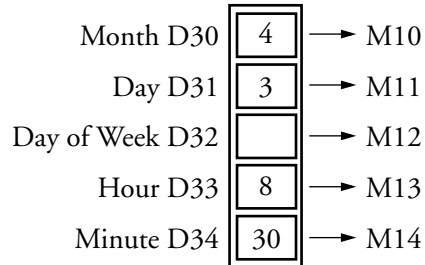
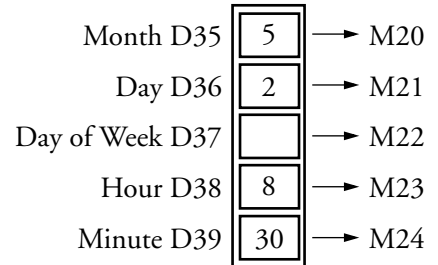
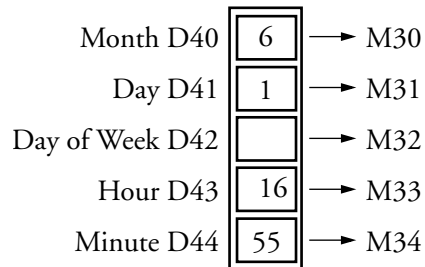
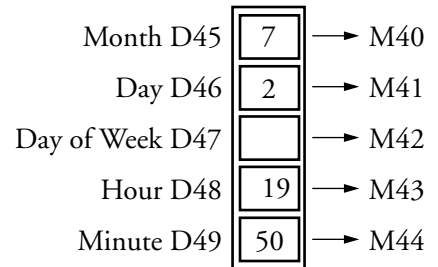
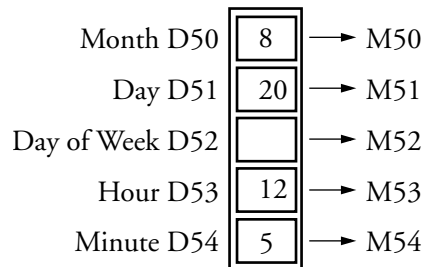
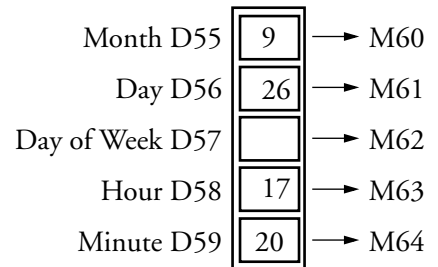
Comparison Data	Month	Day	Day of Week	Hour	Minute
1	M10	M11	M12	M13	M14
2	M20	M21	M22	M23	M24
3	M30	M31	M32	M33	M34
4	M40	M41	M42	M43	M44
5	M50	M51	M52	M53	M54
6	M60	M61	M62	M63	M64

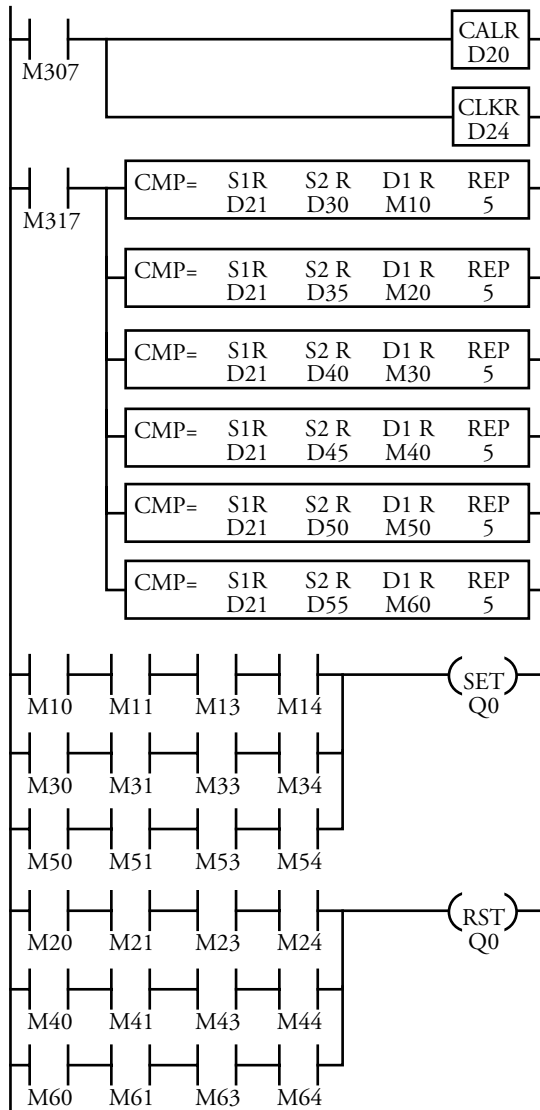
Calendar/Clock Readout Data

Year D20	<input type="text"/>
Month D21	<input type="text"/>
Day D22	<input type="text"/>
Day of Week D23	<input type="text"/>
Hour D24	<input type="text"/>
Minute D25	<input type="text"/>
Second D26	<input type="text"/>

This program does not compare the data of the day of week and second.

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**Comparison Data 1
(Turn on output Q0)****Comparison Data 2
(Turn on output Q0)****Comparison Data 3
(Turn on output Q0)****Comparison Data 4
(Turn on output Q0)****Comparison Data 5
(Turn on output Q0)****Comparison Data 6
(Turn on output Q0)**

M317 is the in-operation special internal relay. While the program is executed, the clock read (CLKR) instruction reads the calendar and clock data to data registers D20 (year), D21 (month), D22 (day), D23 (day of week), D24 (hour), D25 (minute), and D26 (second).

The compare equal to (CMP=) instruction compares the current values of the month, day, day of week, hour, and minute in data registers D21 through D25 with the comparison data in five consecutive data registers. When data matches, a corresponding internal relay is turned on.

The first CMP= makes the following comparison and turns internal relays on:

D21 ↔ D30 → M10 (month)
D22 ↔ D31 → M11 (day)
D23 ↔ D32 → M12 (day of week)
D24 ↔ D33 → M13 (hour)
D25 ↔ D34 → M14 (minute)

The next CMP= compares D21–D25 with D35–D39 and turns on internal relays M20 through M24. Subsequent CMP= instructions make similar comparisons.

When the current time matches comparison data 1 of the month, day, hour, and minute; then, internal relays M10, M11, M13, and M14 are turned on, and output Q0 is turned on. When the current time matches comparison data 3 or 5, output Q0 is also turned on.

When the current time matches comparison data 2 of the month, day, hour, and minute, internal relays M20, M21, M23, and M24 are turned on and output Q0 is turned off. When the current time matches comparison data 4 or 6, output Q0 is also turned off. The day of week is not included in the comparison condition.



Right Mouse → Advanced Instructions → Interface

Selecting **Advanced Instructions → Interface →** accesses a sub-menu of instructions: Display (DISP), Digital Read (DGRD), and Analog Read 0 (ANR0).

→ Display (DISP)

Selecting **Advanced Instructions → Interface → Display (DISP)** displays the Display (DISP) dialog box.

You may also click the toolbar button:




In the DISP field, click the circle of the appropriate selection, either BCD for binary coded decimal conversion or BIN for binary conversion. Enter the quantity of digits to display on the interface in the white field below.

Enter the appropriate tag name (or *nickname*) in the **Tag Name:** field. The data in S1 is the source operand. The data in Q is the destination operand.

Then, enter the associated operand in the **Allocation Number:** field below. This is the operand *from* which data will be moved.

Finally, optionally enter any associated comment in the **Tag Name Comment:** field. This reference may be a maximum of six characters per line for a maximum of four lines.

In the **LAT** field, click the circle of the appropriate selection, either **Low** for a low latch phase or **High** for a high latch phase.

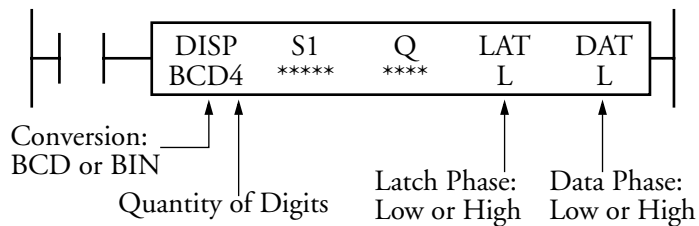
In the **DAT** field, click the circle of the appropriate selection, either **Low** for a low data phase or **High** for a high data phase.

Once the dialog box is complete, click the **OK** button to activate the display instruction on your ladder. To back out of this instruction without utilizing the display instruction, click the **Cancel** button.

To access on-line help, click the **Help** button.

NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure → PLC Selection** option.

The display (DISP) instruction is used to display 1 to 5 digits of the current values and data register data of the timer/counter on seven-segment display units.



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When an input is on, the data designated by source operand S1 is set to the output designated by destination operand Q. This instruction is used to output seven-segment data to display units.

NOTE: The DISP instruction can be used on transistor output type Micro³ base units only. The DISP instruction can be used only once in a user program.

Valid Operands (Standard Processing)

Operand	S1 (Source 1)	Q (Destination)
I	—	—
Q	—	0–25
M	—	—
T	0–31	—
C	0–31	—
R	—	—
D (Micro ³)	0–99	—
D (Micro ³ C)	0–498	—
Constant	—	—
Repeat	—	—

When a timer (T) or counter (C) is used as S1 or S2, the current value of the timer/counter is read out.



Conversion

BCD	To connect decimal display units
BIN	To connect hexadecimal display units

Latch Phase and Data Phase

Select the latch and data phases to match the phases of the display units.

Output Points

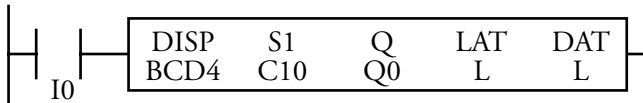
The quantity of required output points is four plus the quantity of digits to display. When displaying the maximum of five digits, nine consecutive output points must be reserved, starting with the first output number designated by operand Q. Make sure that actual output terminals are available for all output allocation numbers. Do not let the output numbers straddle the base and expansion stations in the expansion link system.

Display Processing Time

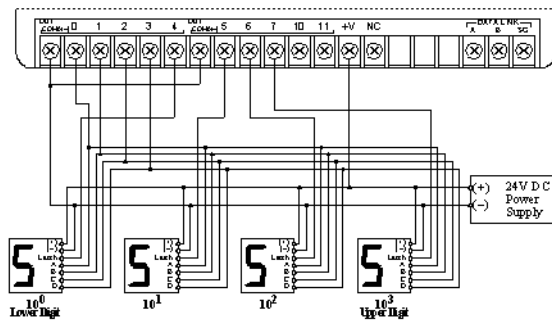
Displaying numerical data requires the following time after the input until the DISP instruction is turned on. Keep the input to the DISP instruction for the period of time shown below to process the display data.

Scan Time	Display Processing Time
Less than 5 ms	$(10 \text{ ms} + 1 \text{ Scan Time}) \times \text{Quantity of Digits}$
5 ms or More	$3 \text{ Scan Times} \times \text{Quantity of Digits}$



Example: DISP

When output I0 is on, the four-digit current value of counter C10 is displayed on the seven-segment digital display unit.

Wiring Diagram: Micro³ Base Unit, FC2A-C24B1

→ **Digital Read (DGRD)**

Selecting **Advanced Instructions** → **Interface** → **Digital Read (DGRD)** displays the **Digital Read (DGRD)** dialog box.

You may also click the toolbar button:




In the **DGRD** field, click the circle of the appropriate selection, either **BCD** for binary coded decimal conversion or **BIN** for binary conversion. Enter the quantity of digits to be digitally read from the interface in the white field below **BIN**.

Enter the appropriate tag name (or *nickname*) in the **Tag Name:** field. The data in **I** is the first input number read. The data in **Q** is the first output number for the digital selection. The data in **D1** is the destination operand.

Then, enter the associated operand in the **Allocation Number:** field.

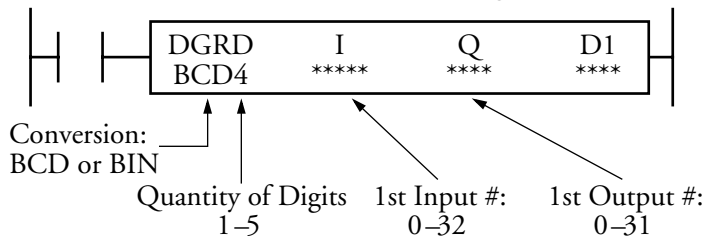
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Finally, optionally enter any associated comment in the **Tag Name Comment:** field. This reference may be a maximum of six characters per line for a maximum of four lines.

Once the dialog box is complete, click the **OK** button to activate the digital read instruction on your ladder. To back out of this instruction without utilizing the digital read instruction, click the **Cancel** button.

To access on-line help, click the **Help** button.

NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure → PLC Selection** option.



When an input is on, the data designated by I and Q is set to 16 internal relays or data registers designated by destination operand D1.

This instruction can be used to set preset values for timer (TIM, TMH, and TMS), counter (CNT), and counter comparison instructions using digital switches.

NOTE: The DGRD instruction can be used on transistor output type Micro³ base units only. The DGRD instruction can be used only once in a user program.

NOTE: Do not use the DGRD instruction between JMP and JEND instructions or between MCS and MCR instructions.

Valid Operands (Standard Processing)

Operand	I	Q	D1 (Destination 1)
Function	First input number read	First output number for digital selection	Destination to store results
I	0–35	—	—
Q	—	0–31	—
M	—	—	0–287
T	—	—	
C	—	—	
R	—	—	
D (Micro ³)	—	—	0–99
D (Micro ³ C)	—	—	0–498
Constant	—	—	—
Repeat	—	—	—

NOTE: In the high-speed processing mode, operands for advanced instructions are limited.

Conversion

BCD	To connect BCD digital switches
BIN	To connect hexadecimal digital switches



Input Points

The inputs are used to read the data from the digital switches. The quantity of required input points is always four. Four input points must be reserved starting with the input number designated by I. Make sure that actual input terminals are available for all input numbers. Do not let the input numbers straddle the base and expansion stations in the expansion link system.

Output Points

Outputs are used to select the digits to read. The quantity of required output points is equal to the quantity of digits to read. When connecting the maximum of five digital switches, five output points must be reserved starting with the output number designated by Q. When an expansion unit is used with the base unit, consecutive output numbers are allocated automatically between the base and expansion units. Make sure that actual output terminals are available for all output numbers. Do not let the output numbers straddle the base and expansion stations in the expansion link system.

Digital Switch Data Reading Time

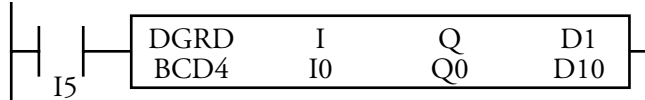
Reading digital switch data requires the following time after the input until the DGRD instruction is turned on. Keep the input to the DGRD instruction for the period of time shown below to read the digital switch data.

Scan Time	Digital Switch Data Reading Time
Scan Time > (Soft Filter + 3 msec) / 2	2 Scan Times x (Quantity of Digits + 1)
Scan Time <= (Soft Filter + 3 msec) / 2	(Soft filter + 3 msec) x (Quantity of Digits + 1)



The following example demonstrates a program to read data from four digital switches to a data register in the 16-point transistor sink output type Micro³ or Micro³C base unit.

Example: DGRD

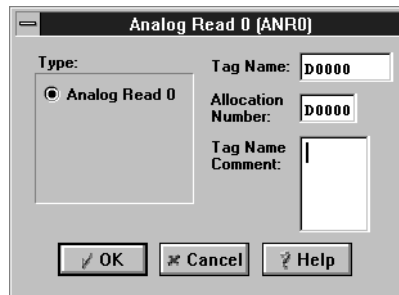


When input I5 is on, the four-digit value from BCD digital switches is read to data register D10.

→ Analog Read 0 (ANR0)

Selecting **Advanced Instructions** → **Interface** → **Analog Read 0 (ANR0)** displays the **Analog Read 0 (ANR0)** dialog box.

You may also click the toolbar button:



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The **Analog Read 0** option in the **Type:** field remains selected.

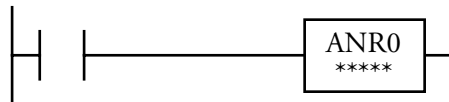
Enter the tag name (or *nickname*) in the **Tag Name:** field. Then, enter the associated operand in the **Allocation Number:** field. This is the operand used to read to the data register designated as the destination.

Finally, optionally enter any associated comment in the **Tag Name Comment:** field. This reference may be a maximum of six characters per line for a maximum of four lines.

Once the dialog box is complete, click the **OK** button to activate the analog instruction on your ladder. To back out of this instruction without utilizing the analog instruction, click the **Cancel** button.

To access on-line help, click the **Help** button.

NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure → PLC Selection** option.



When an input is on, the value (0–249) set with analog potentiometer 0 is read to the data register designated as the destination.

This instruction is useful for adjusting the preset values of timer (TIM, TMH, and TMS) and pulse (PULS and PWM) instructions.

NOTE: Analog potentiometer 0 is provided on all models of Micro³ and Micro³C base units. Analog potentiometer 1 is provided on 16-point type and 24-point type Micro³ base units only. So, ANR0 can be used on all models, but ANR1 can be used on 16-point type and 24-point type Micro³ models only.

Valid Operands (Standard Processing)

Function	Destination to store the analog potentiometer value
Operand: D	0–99 for Micro ³ ; 0–498 for Micro ³ C

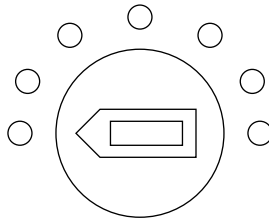
In the high-speed processing mode, data registers for these instructions are limited to D0 through D31.

Since the ANR0 and ANR1 instructions are executed in each scan while input is on, a pulse input from an SOTU or SOTD instruction should be used as required.

Analog Potentiometer Settings

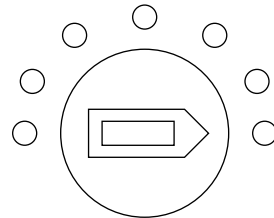
The analog potentiometer values and set positions are shown below.

Turned to the Left Extremity



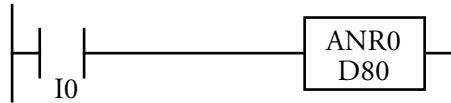
Maximum Value = 0

Turned to the Right Extremity



Maximum Value = 249

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Example: ANR0

When input I0 is on, the value from analog potentiometer 0 is read to data register D80.

Right Mouse → Advanced Instructions → Pulse and A/D Conversion

Selecting **Advanced Instructions → Pulse and A/D Conversion →** accesses a sub-menu of instructions: Pulse Output (PULS), Pulse Width Modulation (PWM), and Analog To Digital Conversion (A/D).

NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure → PLC Selection** option.

→ **Pulse Output (PULS)**

Selecting **Advanced Instructions** → **Pulse and A/D Conversion** → **Pulse Output (PULS)** displays the **Pulse Output (PULS)** dialog box.

You may also click the toolbar button:




In the **Type:** field, click the **Pulse Output** circle.

In the **Base Frequency** field, click the circle of the appropriate selection. For pulse output types, selections include: **4882.81 Hz**; **9765.63 Hz**; **78,125 Hz**; or **156,250 Hz**. This selection determines the pulse width coefficient.

Enter the tag name (or *nickname*) in the **Tag Name:** field. Then, enter the associated operand in the **Allocation Number:** field. This is the operand used to generate pulse outputs.

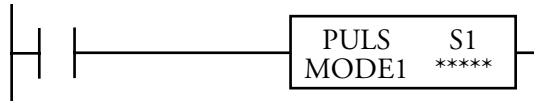
Finally, optionally enter any associated comment in the **Tag Name Comment:** field. This reference may be a maximum of six characters per line for a maximum of four lines.

Once the dialog box is complete, click the **OK** button to activate the pulse instruction on your ladder. To back out of this instruction without utilizing the pulse instruction, click the **Cancel** button.

To access on-line help, click the **Help** button.

The pulse output (PULS) instruction is used to generate pulse outputs of 9.574 through 13020.8 Hz which can be used to control pulse motors for simple position control applications. The output pulse ratio is fixed at 50%.

The PULS and PWM instructions can be used on transistor output type Micro³ or Micro³C base units only.



When an input is on, output Q0 generates a pulse output. The output pulse frequency is determined by the base frequency selection and source operand S1 according to the equation on page 9-153. When the input is off, output Q0 remains off.

NOTE: Either the PULS or PWM instruction can be used only once in a user program.

Valid Operands (Standard Processing)

Operand	S1 (Source 1)
Function	Pulse width coefficient
D	0–99 for Micro ³ ; 0–498 for Micro ³ C
Constant	0–249

While the Micro³ base unit is running, the base frequency selection cannot be changed. To change the output pulse frequency during operation, use a data register as source operand S1 and change the value of the data register.

When a data register is designated as S1, make sure that the value of the data register does not exceed 249. If the value of the data register designated as S1 exceeds 249 during operation, then a user program execution error will occur. Then the ERR1 indicator on the Micro³ base unit is lit, and special internal relay M304 is also turned on. Correct the program, and transfer the corrected program to the Micro³ base unit.

When a data register is designated as S1, the data is read as the user program is scanned. When changing the value of the data register designated as S1, change the value slowly in comparison to the output frequency.

When Q0 is monitored while the PULS instruction is executed, Q0 remains on and the output indicator also remains on. When input to the PULS instruction is turned off while the pulse output is on, the output is turned off after a complete pulse is generated.

Output Frequency

WindLDR displays MODE1 through MODE4 on the ladder. However, when selecting the base frequency in the dialog box, the actual frequencies are displayed, not the MODE.

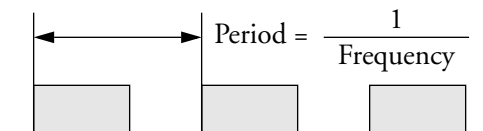


MODE	Base Frequency	Frequency Range (Coefficient 249 through 0)
MODE1	4882.81 Hz	9.574 through 406.901 Hz
MODE2	9765.63 Hz	19.148 through 813.802 Hz
MODE3	78,125 Hz	153.186 through 6510.42 Hz
MODE4	156,250 Hz	306.373 through 13020.8 Hz

The output frequency is determined by the following equation.

$$\text{Output Frequency} = \frac{\text{Base Frequency (MODE)}}{(\text{Pulse Width Coefficient S1} + 6) \times 2} \text{ [Hz]}$$

$$\text{Pulse Width Coefficient S1} = \frac{\text{Base Frequency (MODE)}}{\text{Output Frequency} \times 2} - 6$$



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Example: PULS

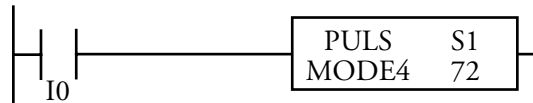
This example explains how to set 1 kHz output pulses using the PULS instruction. From the preceding table, base frequencies 78,125 Hz and 156,250 Hz can be used to set 1 kHz. If MODE4 is selected, then:

$$\text{Pulse Width Coefficient S1} = \frac{\text{Base Frequency (156,250 Hz)}}{\text{Output Frequency} \times 2} - 6$$

$$\text{Pulse Width Coefficient S1} = \frac{156250}{1000 \times 2} - 6$$

$$\text{Pulse Width Coefficient S1} = 72.125$$

Pulse width coefficient 72 should be used as source operand S1.



When input I0 is on, output Q0 generates pulse outputs of 1001.6 Hz.

$$\text{Output Frequency} = \frac{156250}{(72 + 6) \times 2} - 6$$

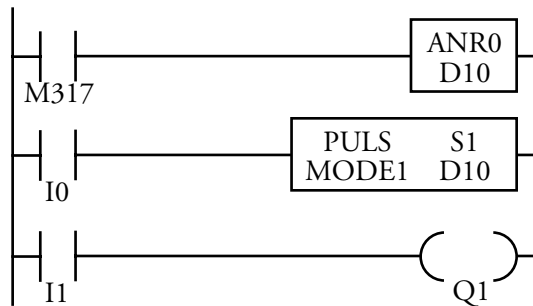
Example: Pulse Motor Speed Control Using PULS Instruction

This example demonstrates a program to control the rotating speed of a pulse motor using the PULS instruction. Analog potentiometer 0 is used to change the pulse motor speed. When input I0 is on, the pulse output is generated to rotate the pulse motor. When input I1 is on, the pulse motor rotates in the reverse direction.

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Operands

I0	Input to execute the PULS instruction and start the pulse motor
I1	Input to reverse the pulse motor rotation
Q0	Pulse output
Q1	Output to change the pulse motor rotation
D10	Pulse width coefficient
MODE1	9.574 through 406.901 Hz



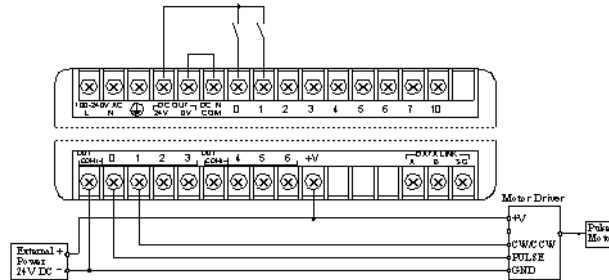
M317 is the in-operation output special internal relay which remains on while the program is executed.

The analog read 0 (ANR0) instruction sets the value of analog potentiometer 0 to data register D10.

While input I0 is on, the PULS instruction is executed to generate output pulses determined by the value of D10. Output Q0 sends out the output pulses.

When input I1 is on, output Q1 is turned on to reverse the pulse motor.

I/O Wiring Diagram: PULS



→ Pulse Width Modulation (PWM)

Selecting Advanced Instructions → Pulse and A/D Conversion → Pulse Width Modulation (PWM) displays the Pulse Width Modulation (PWM) dialog box.

You may also click the toolbar button:



Pulse Width Modulation (PWM)

<p>Type:</p> <p><input type="radio"/> Pulse Output</p> <p><input checked="" type="radio"/> Pulse Modulation</p> <p>Pulse Cycle Period</p> <p><input checked="" type="radio"/> 51.2 msec</p> <p><input type="radio"/> 25.6 msec</p> <p><input type="radio"/> 3.2 msec</p> <p><input type="radio"/> 1.6 msec</p>	<p>Tag Name: <input type="text" value="S1"/></p> <p>Allocation Number: <input type="text" value="D0000"/></p> <p>Tag Name Comment: <input type="text"/></p>
--	---

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In the **Type:** field, click circle to the left of the **Pulse Modulation** option.

In the **Base Frequency** field, click the circle of the appropriate selection. For pulse modulation types, selections include: **51.2 msec**; **25.6 msec**; **3.2 msec**; or **1.6 msec**. This figure notes the base frequency for which calculations will be performed.

Enter the tag name (or *nickname*) in the **Tag Name:** field. Then, enter the associated operand in the **Allocation Number:** field.

Finally, optionally enter any associated comment in the **Tag Name Comment:** field. This reference may be a maximum of six characters per line for a maximum of four lines.

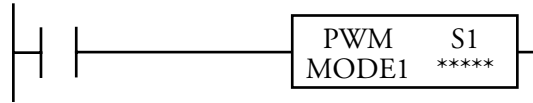
Once the dialog box is complete, click the **OK** button to activate the pulse instruction on your ladder. To back out of this instruction without utilizing the pulse instruction, click the **Cancel** button.

To access on-line help, click the **Help** button.

The pulse width modulation (PWM) instruction is used to generate pulse outputs of a 51.2, 25.6, 3.2, or 1.6 msec period with a pulse width that can be varied between 0.4% and 100% increments.



The PULS and PWM instructions can be used on transistor output type Micro³ or Micro³C base units only.



When an input is on, output Q0 generates a pulse output. The period of the pulse output is selected from 51.2, 25.6, 3.2, or 1.6 msec. The output pulse width ratio is determined by the source operand S1 according to the equation on page 9-160. When the input is off, output Q0 remains off.

NOTE: Either the PULS or PWM instruction can be used only once in a user program.

Valid Operands (Standard Processing)

Operand	S1 (Source 1)
Function	Pulse width coefficient
D	0–99 for Micro ³ ; 0–498 for Micro ³ C
Constant	0–249

The pulse cycle period (base selection) cannot be changed during operation. To change the duty ratio during operation, use a data register as source operand S1 and change the value of the data register.

If the value of the data register designated as S1 is between 0 and 4, the pulse width coefficient is designated as 5.

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When a data register is designated as S1, make sure that the value of the data register does not exceed 249. If the value of the data register designated as S1 exceeds 249 during operation, a user program execution error will occur. Then the ERR1 indicator on the Micro³ base unit is lit, and special internal relay M304 turns on. Correct the program, and transfer the corrected program to the base unit.

When a data register is designated as S1, the data is read as the user program is scanned. When changing the value of the data register designated as S1, change the value slowly in comparison to the output frequency.

When Q0 is monitored while the PWM instruction is executed, Q0 remains on and the output indicator also remains on. When the input to the PWM instruction is turned off while the pulse output is on, the output is turned off after a complete pulse is generated.

Output Pulse Width Ratio

Select MODE1 through MODE4 to determine the pulse cycle period.

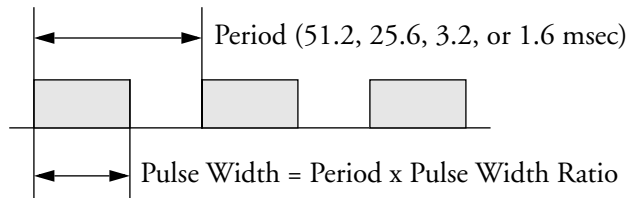
MODE	Pulse Cycle Period
MODE1	51.2 msec
MODE2	25.6 msec
MODE3	3.2 msec
MODE4	1.6 msec



The output pulse width ratio is determined by the following equation. The output frequency is determined by the following equation.

$$\text{Pulse Width Ratio} = \frac{(\text{Pulse Width Coefficient } S1 + 1)}{250}$$

$$\text{Pulse Width} = \text{Period} \times \frac{(\text{Pulse Width Coefficient } S1 + 1)}{250} \quad [\text{msec}]$$



Variable Range of Pulse Width Ratio

When S1 is a data register	2.4% through 100% in 0.4% increments
When S1 is a constant	0.4% through 100% in 0.4% increments

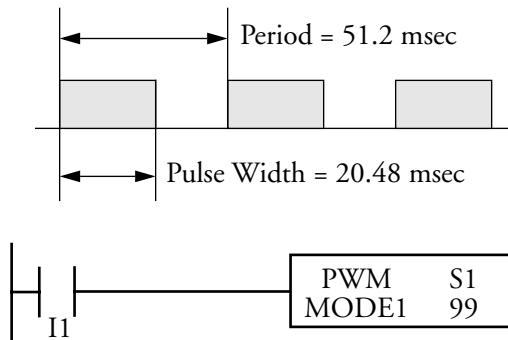
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To turn the pulse output off, turn the input to the PWM instruction off.

$$\text{Pulse Width} = \text{Period} \times \frac{(\text{Pulse Width Coefficient } S1 + 1)}{250}$$

$$\text{Pulse Width} = 51.2 \text{ msec} \times \frac{(99 + 1)}{250}$$

$$\text{Pulse Width} = 20.48 \text{ msec}$$



When input I1 is on, output Q0 generates the pulse output shown above.

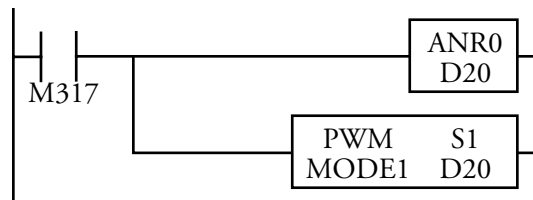
Example: Illumination Control Using PWM Instruction

This example demonstrates a program to control incandescent lamp illumination using the PWM instruction. Analog potentiometer 0 is used to change the illumination intensity.

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Operands

Q0	Pulse output
D20	Pulse width coefficient
MODE1	Pulse cycle period 51.2 msec



M317 is the in-operation output special internal relay which remains on while the program is executed.

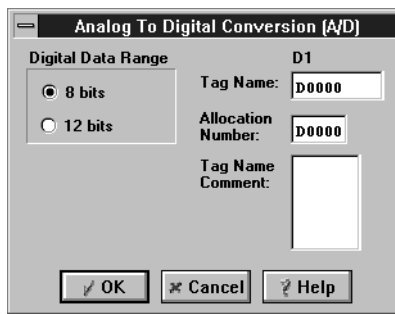
The analog read 0 (ANR0) instruction sets the value of analog potentiometer 0 to D20.

The PWM instruction is executed to generate output pulses. The pulse width ratio is determined by the value of D20. Output Q0 sends out the output pulses.

→ Analog To Digital Conversion (A/D)

Selecting **Advanced Instructions** → **Pulse and A/D Conversion** → **Analog To Digital Conversion (A/D)** displays the **Analog To Digital Conversion (A/D)** dialog box.

You may also click the toolbar button:



In the **Digital Data Range** field, click the circle of the appropriate selection, either **8 bits** or **12 bits**. This figure notes the analog to digital resolution.

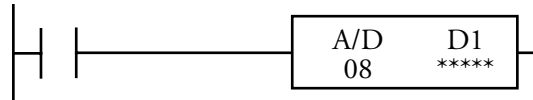
Enter the tag name (or *nickname*) in the **Tag Name:** field. Then, enter the associated operand in the **Allocation Number:** field below. This operand indicates the destination of the data conversion.

Finally, optionally enter any associated comment in the **Tag Name Comment:** field. This reference may be a maximum of six characters per line for a maximum of four lines.

Once the dialog box is complete, click the **OK** button to activate the A/D conversion instruction on your ladder. To back out of this instruction without utilizing the A/D conversion instruction, click the **Cancel** button.

To access on-line help, click the **Help** button.

The analog/digital conversion (A/D) instruction is used to convert an analog value from the A/D converter unit to a digital value and stores the result to a data register.



When an input is on, the analog data from the A/D converter unit (FC2A-AD1, -AD2, -AD3, -AD4, or -AD5) connected to input I0 is converted to a digital value and set to a data register designated by destination operand D1.

The resolution of the A/D conversion can be selected from 8 bits or 12 bits.

NOTE: Either the A/D or high-speed counter (HSC) instruction can be used only once in a user program. The A/D converter unit can be connected to input I0 of the Micro³ or Micro³C at the base station only, not at the expansion station.

Valid Operands (Standard Processing)

Operand	D1 (Destination 1)
Function	Destination to store data
Operand: D	0 – 99 for Micro ³ ; 0 – 498 for Micro ³ C

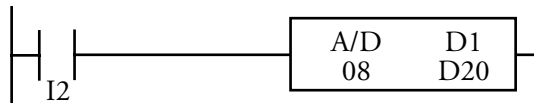
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Digital Data Range

Depending on the selected resolution of the A/D conversion, the digital data stored in the data register is limited to the range shown below.

Resolution	Digital Data Range
8 bits	0–249, or 250
12 bits	0 through 3999, or 4000

If the input to the A/D converter unit exceeds the input range, then an overflow occurs. Additionally, when the resolution is set to 8 bits, 250 is set. When the resolution is set to 12 bits, 4000 is set.



When input I2 is on, the analog data from the A/C converter unit is converted to a digital value with an 8-bit resolution and set to data register D20.

Right Mouse → **Advanced Instructions** → **High-Speed Counter**

Selecting **Advanced Instructions** → **High-speed Counter** → accesses a sub-menu of instructions: Single-stage Comparison (HSC0), Multi-stage Comparison (HSC1), Pulse Output Control (HSC2), and Gate Control (HSC3).

NOTE: The right mouse button is context-sensitive to the specific PLC selected. This chapter is written in reference to the Micro³ PLC. To access the right mouse button instructions for another PLC, select the **Configure** → **PLC Selection** option.



Introduction to Counters

The Micro³ and Micro³C feature high-speed counter functions which can be used for position control by counting high-speed pulses or for simple motor control in combination with the pulse output. This function can also be used in combination with a pulse generator to measure lengths or widths of objects.

The ordinary counter instruction counts only one pulse in one scan, and the counting speed depends on the scan time. The high-speed counter can count many input pulses in one scan and make it possible to count high-speed pulses faster than the scan time. If the high-speed counter counts input pulses representing a position, the current position can be determined. This function is useful for position control.

The HSC0 is a high-speed counter with a single-stage comparison function. When the current value is equal to or greater than the preset value (4,294,967,295 maximum), a designated output or internal relay is turned on.

The HSC1 is a multi-stage comparison counter. The preset value and output data is programmed in data registers. When a preset value is reached (4,294,967,295 maximum), a designated output or internal relay is turned on.

The HSC2 is a pulse output control counter used with the PULS (pulse output) instruction. When a preset value is reached, a designated output or internal relay is turned on and output pulses at output Q0 is turned off.

The HSC3 is a gate-controlled counter without a comparison function. When the gate input is turned off, the current value is moved to a designated data register.



High-Speed Counter Specifications (Hard Filter Value: 10)

High-Speed Counter	HSC0	HSC1	HSC2	HSC3
Counted Value Range	0 to 4,294,967,295 (FFFF FFFFh)	0 to 4,294,967,295 (FFFF FFFFh)	0 to 4,294,967,295 (FFFF FFFFh)	0 to 65,535 (FFFFh)
Points	1	1	1	1
Phase	Single	Single	Single	Single
Maximum Frequency	10 kHz	5 kHz	5 kHz (4 kHz when using a program loader)	10 kHz

NOTE: The input response frequency of the high-speed counter depends on the hard filter setting. The soft filter does not affect the high-speed counter function.



→ **Single-stage Comparison (HSC0)**

Selecting **Advanced Instructions** → **High-speed Counter** → **Single-stage Comparison (HSC0)** displays the **Single-stage Comparison (HSC0)** dialog box.

You may also click the toolbar button:




In the **HSC0** field, click the circle of the appropriate selection: **Low**, **High**, or **Disable**. This selection is used to reset the current value of the high speed counter 0.

Enter the tag name (or *nickname*) in the **Tag Name:** fields. Then, enter the associated operands in the **Allocation Number:** fields below. The **S1** fields indicate the preset value. The **D1** fields indicate the high-speed counter output.

Finally, optionally enter any associated comments in the **Tag Name Comment:** fields. This reference may be a maximum of six characters per line for a maximum of four lines.

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Once the dialog box is complete, click the **OK** button to activate the high-speed instruction on your ladder. To back out of this instruction without utilizing the high-speed instruction, click the **Cancel** button.

To access on-line help, click the **Help** button.



High-speed counter 0 counts input pulses to input I0. When the current value is equal to or greater than the preset value designated by source operand S1, the output or internal relay designated by destination operand D1 is turned on.

The current value of the high-speed counter is reset to zero when the Micro³ or Micro³C is powered up. The high-speed counter holds the current value while the Micro³ or Micro³C is stopped and restarts counting input pulses starting with the existing current value. Include the hard reset or soft reset in the user program, if necessary.

NOTE: Only one HSC0–HSC3 and A/D instruction can be used in each user program.

Allocation Numbers

The HSC0 instruction uses the following input and internal relay numbers:

Pulse input	Input I0
Hard reset input	Input I1
Soft reset special internal relay	Internal relay M315 (when M315 is on, the current value is reset to zero)

Operands Possible (Standard Processing Mode)

Operand	S1 (Source 1)	D1 (Destination 1)
Function	Preset value	High-speed counter output
I	—	—
Q	—	0–31
M	—	0–287
T	—	—
C	—	—
R	—	—
D (Micro ³)	0–99	—
D (Micro ³ C)	0–498	—
Constant	1–4,294,967,295	—
Repeat	—	—

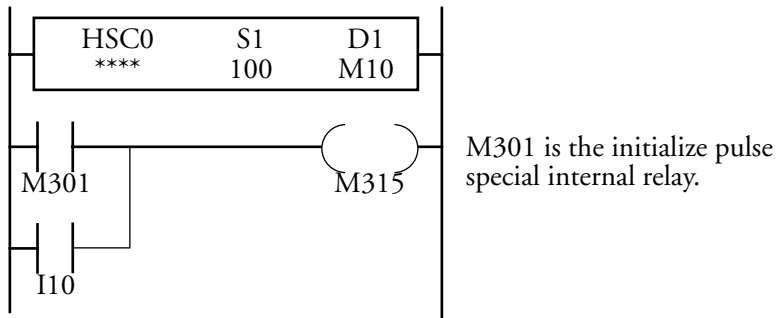


Hard Reset Selection

Input I1 can be used to reset the current value of high-speed counter HSC0.

LOW	Resets the current value when input I1 is turned off. HSC0 is enabled while I1 is on.
HIGH	Resets the current value when input I1 is turned on. HSC0 is enabled while I1 is off.
*—	Disables the hard reset. (Input I1 can be used as an ordinary input.)

Soft Reset Special Internal Relay M315



Preset Value

The preset value can be between 1 and 4,294,967,295 (FFFF FFFFh), which is designated using a constant or two consecutive data registers. The first data register designated by source operand S1 stores the upper digits, and the next data register stores the lower digits.

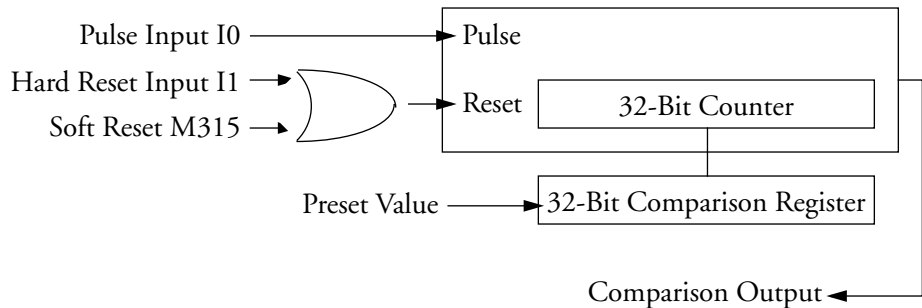
If the preset value designated by a data register is changed during the high-speed counter operation, then the high-speed counter remains unchanged for that cycle. The change will be reflected in the next count cycle after resetting.

Input Filter and Input Frequency

The Micro³ and Micro³C have hard and soft filter functions. Only the hard filter works on high-speed counter instructions. The hard filter settings affect the input response. The maximum input frequency for the HSC0 instruction is 10 kHz.

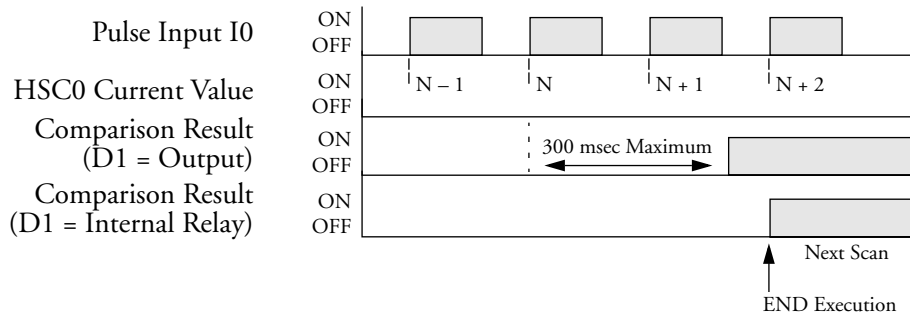
Block Diagram (HSC0: Single-Stage Comparison)

HSC0 counts input pulses to input I0. When the preset value is reached, the comparison output is turned on.



Output Delay in High-Speed Counter HSC0

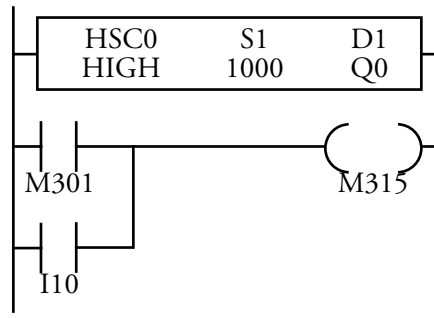
After the HSC0 has counted the Nth input pulse (the preset value), the output or internal relay, designated by destination operand D1, is turned on with a delay shown below.



When an output is designated as destination operand D1, the maximum output delay can be 300 microseconds, not including the delay in the hardware.

When an internal relay is designated as destination operand D1, the delay can be one scan time maximum.

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Example: HSC0

I0	Pulse input
I1	Hard reset input (HSC0 is reset when I1 is on because the hard reset is set to HIGH)
I10	Soft reset input to turn on soft reset special internal relay M315

M301 is the initialize pulse special internal relay used to turn on the soft reset special internal relay M315 at start up.

While hard reset input I1 is off, the HSC0 instruction counts input pulses to input I0. When the HSC0 current value reaches 1000, output Q0 is turned on.

When hard reset input I1 or soft reset input I10 is turned on, the HSC0 current value is reset to zero.

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→ **Multi-stage Comparison (HSC1)**

Selecting **Advanced Instructions** → **High-speed Counter** → **Multi-stage Comparison (HSC1)** displays the **Multi-stage Comparison (HSC1)** dialog box.

You may also click the toolbar button:



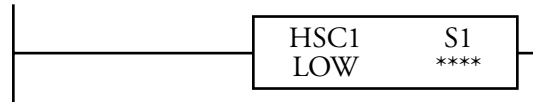

In the **HSC1** field, click the circle of the appropriate selection: **Low**, **High**, or **Disable**. This selection is used to reset the current value of the high speed counter 1.

Enter the tag name (or *nickname*) in the **Tag Name:** field. Then, enter the associated operands in the **Allocation Number:** field below. The **S1** fields indicate the source of the multi-stage preset data comparison.

Finally, optionally enter any associated comments in the **Tag Name Comment:** field. This reference may be a maximum of six characters per line for a maximum of four lines.

Once the dialog box is complete, click the **OK** button to activate the high-speed instruction on your ladder. To back out of this instruction without utilizing the high-speed instruction, click the **Cancel** button.

To access on-line help, click the **Help** button.



Multi-stage high-speed counter HSC1 counts input pulses to input I0 and compares the current value with multiple preset values. When the current value reaches the first preset value, the first comparison output is turned on. When the second preset value is reached, the first comparison output is turned off and the second comparison output is turned on, and so on.

The high-speed counter current value is reset to zero when the Micro³ or Micro³C is powered up. The high-speed counter holds the current value while Micro³ or Micro³C is stopped and restarts counting input pulses starting with the existing current value. Include the hard reset or soft reset in the user program, if necessary.

NOTE: One instruction, HSC0 through HSC3 and A/D, can be used only once in a user program.

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Allocation Numbers

The HSC1 instruction uses the following input and internal relay numbers:

Pulse input	Input I0
Hard reset input	Input I1
Soft reset special internal relay	Internal relay M315 (when M315 is on, the current value is reset to zero)

Operands Possible (Standard Processing Mode)

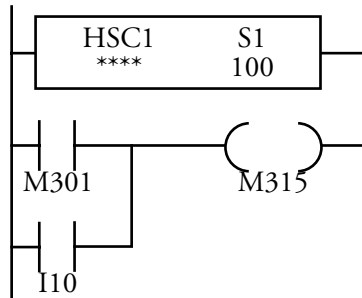
Operand	Function	D
S1 (Source 1)	Multi-stage preset data	0–99 for Micro ³ 0–498 for Micro ³ C

Hard Reset Selection

Input I1 can be used to reset the current value of high-speed counter HSC1.

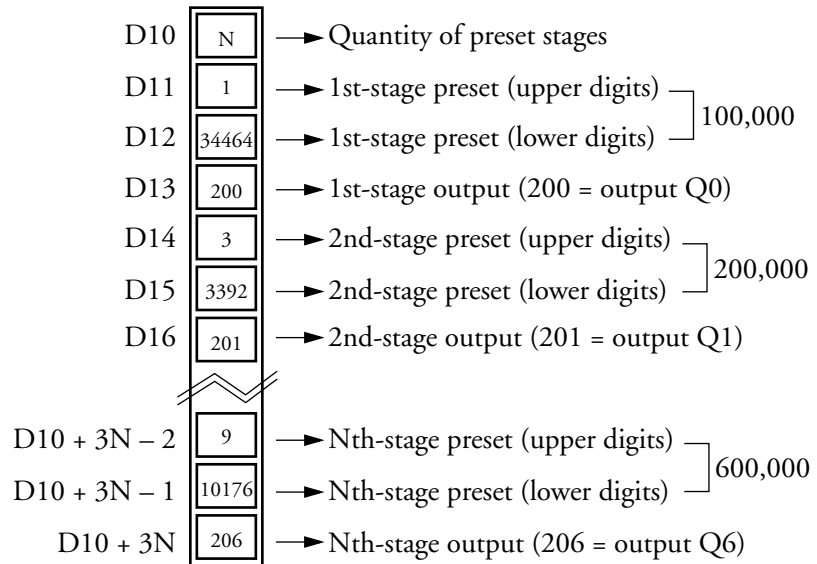
LOW	Resets the current value when input I1 is turned off. HSC1 is enabled while I1 is on.
HIGH	Resets the current value when input I1 is turned on. HSC1 is enabled while I1 is off.
*—	Disables the hard reset. (Input I1 can be used as an ordinary input.)



Soft Reset Special Internal Relay M315

M301 is the initialize pulse special internal relay.

In addition to the hard reset using input I1, the current value of the high-speed counter can be reset by turning special internal relay M315 on using another input, output, or internal relay. M315, if used, must be programmed immediately after the HSC instruction as shown in the previous example.

When data register D10 is designated as source operand S1

Multi-Stage Data Setting

The data of comparison stages, preset values, and comparison outputs are stored in consecutive data registers starting with the data register designated by source operand S1.



Store the quantity of preset stages in the first data register.

In the next two data registers, store the upper and lower digits of the preset value for the first stage.

In the fourth data register, store the destination of the first stage comparison output, using the numeric allocation number of the output or internal relay.

Store the data in these data registers before executing the HSC1 instruction.

Preset Value

The preset value can be between 1 and 4,294,967,295 (FFFF FFFFh) which is stored in two consecutive data registers. The first data register stores the upper digits, and the next data register stores the lower digits.

If the preset value is changed during the high-speed counter operation, the high-speed counter remains unchanged for that cycle. The change will be reflected in the next count cycle after resetting.

Numeric and Symbolic Allocation Numbers

Use the numeric allocation numbers to specify the destination of the HSC1 comparison outputs.

Operand	Symbolic		Numeric	
Output	Q0–Q7	Q20–Q27	200–207	220–227
	Q10–Q11	Q30–Q31	210–211	230–231
Internal Relay	M0–M7	M150–M157	400–407	550–557
	M10–M17	M160–M167	410–417	560–567
	M20–M27	M170–M177	420–427	570–577
	M30–M37	M180–M187	430–437	580–587
	M40–M47	M190–M197	440–447	590–597
	M50–M57	M200–M207	450–457	600–607
	M60–M67	M210–M217	460–467	610–617
	M70–M77	M220–M227	470–477	620–627
	M80–M87	M230–M237	480–487	630–637
	M90–M97	M240–M247	490–497	640–647
	M100–M107	M250–M257	500–507	650–657
	M110–M117	M260–M267	510–517	660–667
	M120–M127	M270–M277	520–527	670–677
	M130–M137	M280–M287	530–537	680–687
M140–M147		540–547		

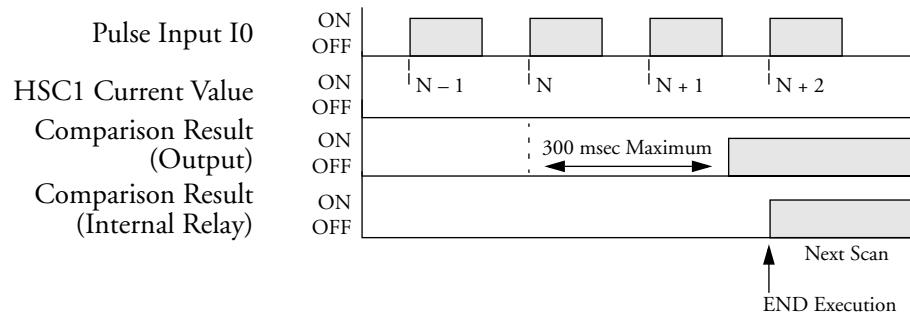


Input Filter and Input Frequency

The Micro³ and Micro³C have hard and soft filter functions. Only the hard filter works on high-speed counter instructions. The hard filter settings affect the input response. The maximum input frequency for the HSC1 instruction is 5 kHz.

Output Delay in High-Speed Counter HSC1

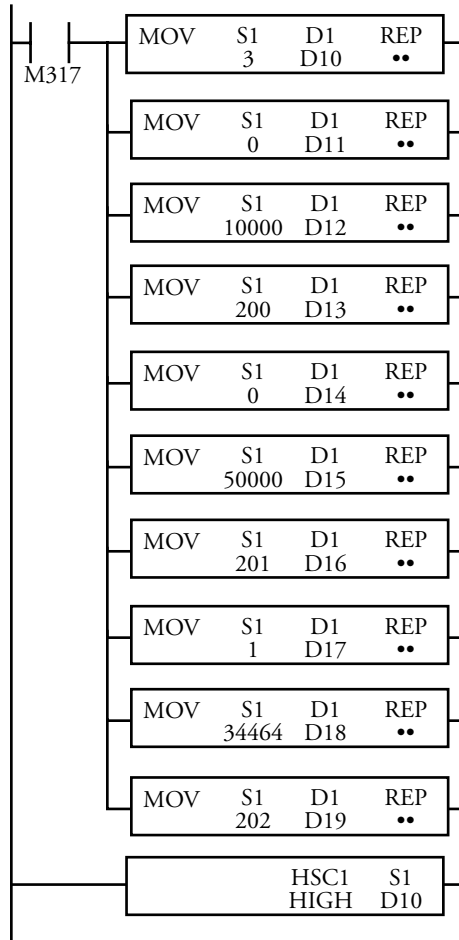
After the HSC1 has counted the Nth input pulse (the preset value), the output or internal relay designated as the destination of the comparison result is turned on with a delay as shown below.



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Example: HSC1

This example demonstrates a three-stage high-speed counter operation using the HSC1 instruction.



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M301 is the initialize pulse special internal relay used to execute the move (MOV) instruction at startup.

The MOV instructions set data to data registers D10–D19.

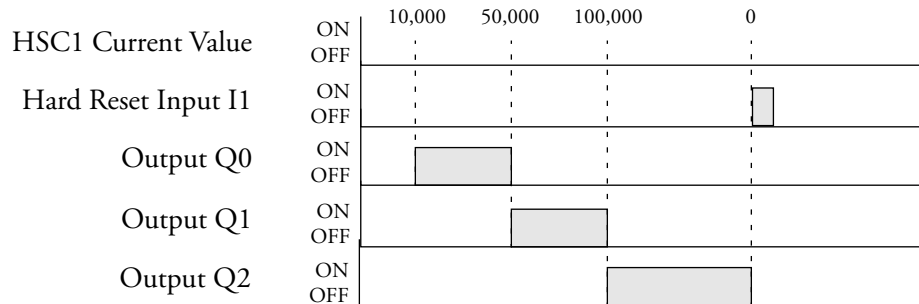
D10	3	→ Quantity of preset stages	
D11	0	→ 1st-stage preset (upper digits)] 10,000
D12	10000	→ 1st-stage preset (lower digits)	
D13	200	→ 1st-stage output (200 = output Q0)	
D14	0	→ 2nd-stage preset (upper digits)] 50,000
D15	50000	→ 2nd-stage preset (lower digits)	
D16	201	→ 2nd-stage output (201 = output Q1)	
D17	1	→ Nth-stage preset (upper digits)] 100,000
D18	34464	→ Nth-stage preset (lower digits)	
D19	202	→ Nth-stage output (202 = output Q2)	

Preset value 100,000 is set to two data registers, D17 (upper digits) and D18 (lower digits). Values for the two data registers are calculated by dividing the preset value by 65,536 (10000h) as follows:

$$\frac{100,000}{65,536} = 1 \text{ and remainder of } 34,464$$

↑
↑
 Upper Digit (D17) Lower Digit (D18)






High-speed counter (HSC1) counts input pulses to input I0. When the first preset value (10,000) is reached, output Q0 is turned on. When the second preset value (50,000) is reached, output Q0 is turned off and Q1 is turned on. When the last preset value (100,000) is reached, output Q1 is turned off and output Q2 is turned on. Output Q2 remains on until hard reset input I1 is turned on to reset the high-speed counter (hard reset is set to HIGH).

Since this example does not cause the soft reset special internal relay to reset at startup, the current value is held when the Micro³ or Micro³C is stopped.

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→ Pulse Output Control (HSC2)

Selecting **Advanced Instructions** → **High-speed Counter** → **Pulse Output Control (HSC2)** displays the **Pulse Output Control (HSC2)** dialog box.

You may also click the toolbar button: 



In the **HSC2** field, click the circle of the appropriate selection: **Low**, **High**, or **Disable**. This selection is used to reset the current value of the high speed counter 2.

Enter the tag name (or *nickname*) in the **Tag Name:** fields. Then, enter the associated operands in the **Allocation Number:** fields below. The **S1** fields indicate the preset value. The **D1** fields indicate the high-speed counter output.

Finally, optionally enter any associated comments in the **Tag Name Comment:** fields. This reference may be a maximum of six characters per line for a maximum of four lines.

Once the dialog box is complete, click the **OK** button to activate the high-speed instruction on your ladder.



To back out of this instruction without utilizing the high-speed instruction, click the **Cancel** button.

To access on-line help, click the **Help** button.

The HSC2 instruction is used with the pulse output (PULS) instruction to generate a predetermined number of pulse outputs. The PULS instruction generates high-frequency output pulses at output Q0. By hard-wiring output Q0 to input I0, HSC2 counts input pulses to input I0. (Input pulses can also be entered to input I0 from another source.) When the HSC2 current value is equal to or greater than the preset value designated by source operand S1, the output or internal relay designated by destination operand D1 is turned on and the pulse output at output Q0 is stopped.



The current value of the high-speed counter is reset to zero when the Micro³ or Micro³C is powered up. The high-speed counter holds the current value while the Micro³ or Micro³C is stopped. It then restarts counting input pulses starting with the existing current value. Include the hard reset or soft reset in the user program, if necessary.

NOTE: One instruction, HSC0 through HSC3 and A/D, can be used only once in a user program.

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Allocation Numbers

The HSC2 instruction uses the following input and internal relay numbers:

Pulse input	Input I0
Hard reset input	Input I1
Soft reset special internal relay	Internal relay M315 (when M315 is on, the current value is reset to zero)

Operands Possible (Standard Processing Mode)

Operand	S1 (Source 1)	D1 (Destination 1)
Function	Preset value	High-speed counter output
I	—	—
Q	—	0–31
M	—	0–287
T	—	—
C	—	—
R	—	—
D (Micro ³)	0–99	—
D (Micro ³ C)	0–498	—
Constant	1–4,294,967,295	—
Repeat	—	—

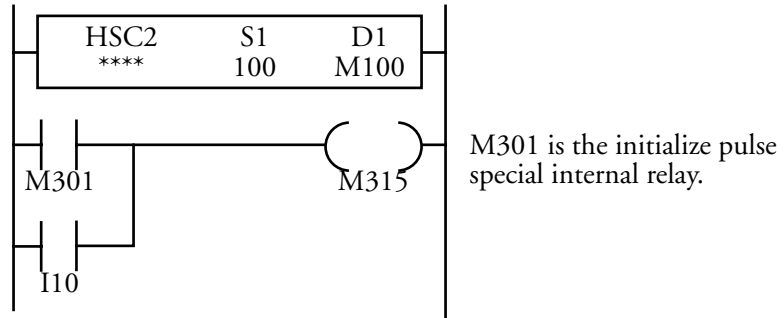


Hard Reset Selection

Input I1 can be used to reset the current value of high-speed counter HSC2.

LOW	Resets the current value when input I1 is turned off. HSC2 is enabled while I1 is on.
HIGH	Resets the current value when input I1 is turned on. HSC2 is enabled while I1 is off.
*—	Disables the hard reset. (Input I1 can be used as an ordinary input.)

Soft Reset Special Internal Relay M315



In addition to the hard reset using input I1, the current value of the high-speed counter can be reset by turning special internal relay M315 on using another input, output, or internal relay. M315, if used, must be programmed immediately after the HSC instruction as shown above.

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Preset Value

The preset value can be between 1 and 4,294,967,295 (FFFF FFFFh) which is designated using a constant or two consecutive data registers. The first data register designated by source operand S1 stores the upper digits, and the next data register stores the lower digits.

If the preset value designated by a data register is changed during the high-speed counter operation, then the high-speed counter remains unchanged for that cycle. The change will be reflected in the next count cycle after resetting.

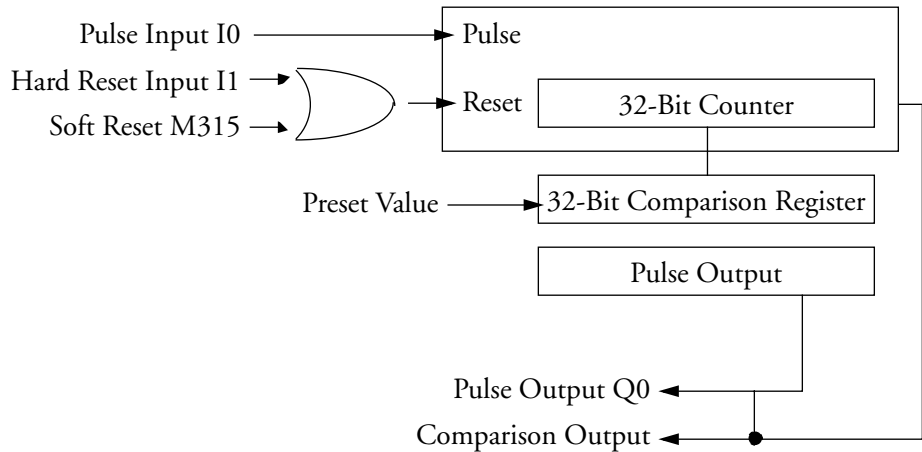
Input Filter

The Micro³ and Micro³C have hard and soft filter functions. Only the hard filter works on high-speed counter instructions. The hard filter settings affect the input response. The maximum input frequency for the HSC2 instruction is 5 kHz (4 kHz when using the program loader).



Block Diagram (HSC2: Pulse Output Control)

HSC2 counts input pulses to input I0. When the preset value is reached, the comparison output is turned on and pulse output Q0 is turned off. The pulse output frequency is determined by the pulse output (PULS) instruction.

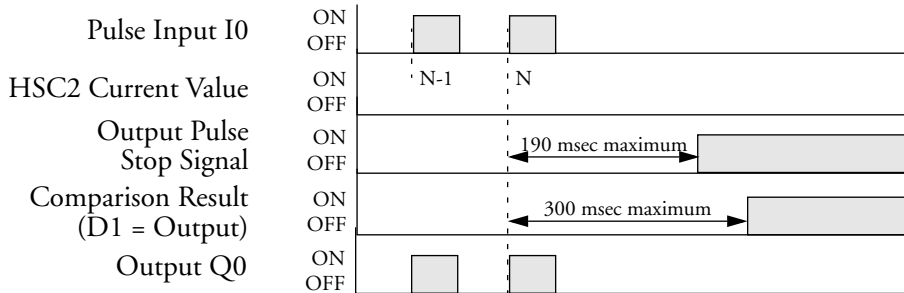


When the preset value is reached, the preset value is turned off.



Output Delay in High-Speed Counter HSC2

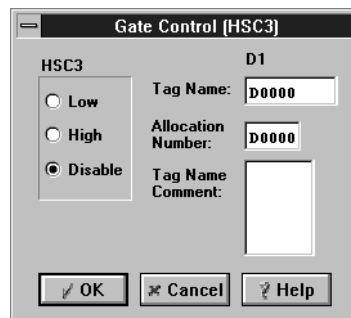
After the HSC2 has counted the Nth input pulse (the preset value), the output or internal relay, designated by destination operand D1, is turned on with a delay as shown below.



→ Gate Control (HSC3)

Selecting **Advanced Instructions** → **High-speed Counter** → **Gate Control (HSC3)** displays the Gate Control (HSC3) dialog box.

You may also click the toolbar button:





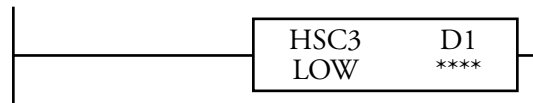
In the **HSC3** field, click the circle of the appropriate selection: **Low**, **High**, or **Disable**. This selection is used to reset the current value of the high speed counter 3.

Enter the tag name (or *nickname*) in the **Tag Name:** field. Then, enter the associated operands in the **Allocation Number:** field below.

Finally, optionally enter any associated comments in the **Tag Name Comment:** field. This reference may be a maximum of six characters per line for a maximum of four lines.

Once the dialog box is complete, click the **OK** button to activate the high-speed instruction on your ladder. To back out of this instruction without utilizing the high-speed instruction, click the **Cancel** button.

To access on-line help, click the **Help** button.



Gate-controlled high-speed counter HSC3 counts input pulses to input I0 while gate control input I2 is on. When gate control input I2 is turned off, the current value is moved to the data register designated by destination operand D1. The HSC3 does not compare the current value with a preset value.

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The HSC3 can count up to 65535. When another input pulse enters at 65535, the current value becomes 0 and special internal relay M316 (HSC3 overflow) is turned on.

The current value of the high-speed counter is reset to zero when the Micro³ or Micro³C is powered up. The high-speed counter holds the current value while the Micro³ or Micro³C is stopped and restarts counting input pulses starting with the existing current value. Include the hard reset or soft reset in the user program, if necessary.

NOTE: One instruction, HSC0 through HSC3 and A/D, can be used only once in a user program.

Allocation Numbers

The HSC3 instruction uses the following input and internal relay numbers:

Pulse input	Input I0
Hard reset input	Input I1
Gate input	Input I2
Soft reset special internal relay	Internal relay M315 (when M315 is on, the current value is reset to zero)
HSC3 overflow special internal relay	Internal relay M316



Operands Possible (Standard Processing Mode)

Operand	Function	D
D1 (Destination 1)	Store the current value	0–99 for Micro ³ ; 0–498 for Micro ³ C

Hard Reset Selection

Input I1 can be used to reset the current value of high-speed counter HSC3.

LOW	Resets the current value when input I1 is turned off. HSC3 is enabled while I1 is on.
HIGH	Resets the current value when input I1 is turned on. HSC3 is enabled while I1 is off.
*—	Disables the hard reset. (Input I1 can be used as an ordinary input.)

Gate Input

Input I2 is allocated as a gate input for the HSC3 instruction. When I2 is on, HSC3 is enabled to count input pulses to input I0. When I2 is turned off, HSC3 is disabled and the current value is moved to the data register designated by destination operand D1. When I2 is turned on again, HSC3 starts counting from the previous current value.

Soft Reset Special Internal Relay M315

In addition to the hard reset using input I1, the current value of the high-speed counter can be reset by turning special internal relay M315 on using another input, output, or internal relay. M315, if used, must be programmed immediately after the HSC instruction as shown above.

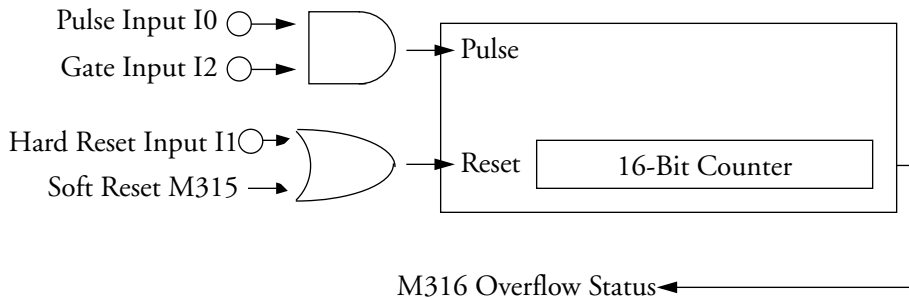


Input Filter and Input Frequency

The Micro³ and Micro³C have hard and soft filter functions. Only the hard filter works on high-speed counter instructions. The hard filter settings affect the input response. The maximum input frequency for the HSC3 instruction is 10 kHz.

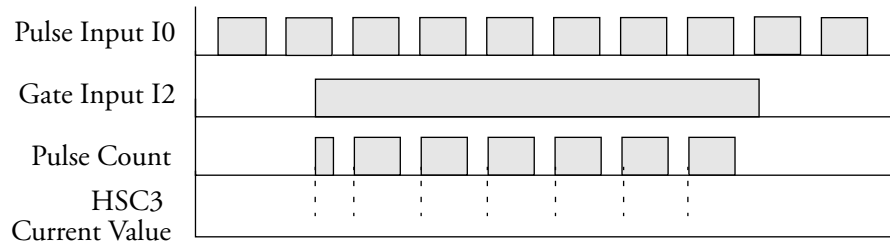
Block Diagram (HSC3: Gate Control)

HSC3 counts input pulses to input I0 while gate input I2 is on and stops counting when I2 is off.

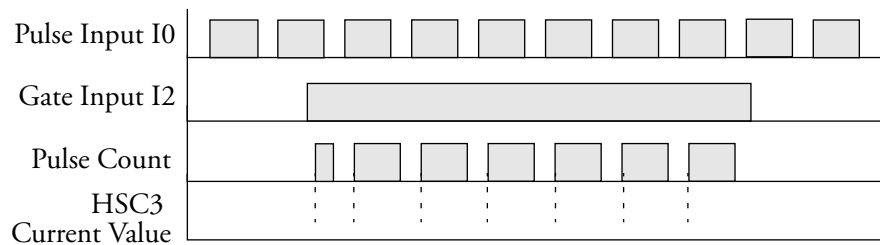


Gate Input in High-Speed Counter HSC3

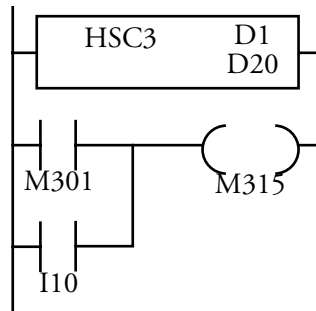
As shown in the figure above, pulse input I0 and gate input I2 are connected in an AND circuit. If gate input I2 is turned on and off while pulse input I0 is on, then the gate pulses are counted as shown below.



When gate input I2 is on, HSC3 counts ON pulses to input I0.



When gate input I0 is on, HSC3 counts ON pulses to input I2.



I0	Pulse input
I1	Hard reset input (HSC3 is reset when I1 is on, because the hard reset is set to HIGH)
I2	Gate input
I10	Soft reset input to turn on soft reset special internal relay M315

M301 is the initialize pulse special internal relay used to turn on soft reset special internal relay M315 at start up.

While hard reset input I1 is off and gate input I2 is on, the HSC3 instruction counts input pulses to input I0. When gate input I2 is turned off, HSC3 stops counting and the current value is moved to data register D20. When gate input I2 is turned on again, HSC3 continues counting from the existing current value.

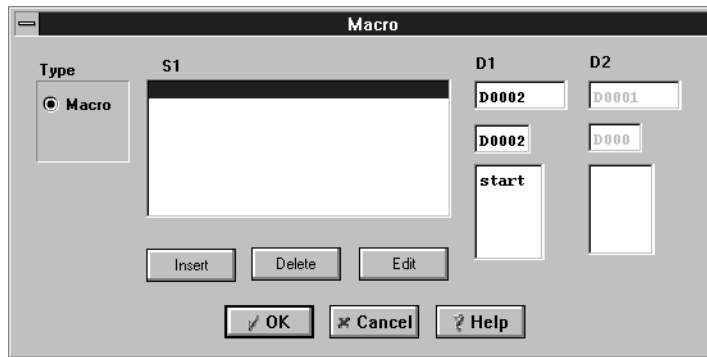
When hard reset input I1 or soft reset input I10 is turned on, the HSC3 current value is reset to zero.

When the current value exceeds 65535, HSC3 overflow special internal relay M316 is turned on to signal an overflow.

Right Mouse → Advanced Instructions → Macro

Selecting **Advanced Instructions → Macro** displays the Macro dialog box.

You may also click the toolbar button:



The Macro instruction is available with the Micro³ and Micro³C PLCs. The Macro instruction uses MOV instructions to move data to PLC data registers. This instruction creates software instructions only; the macro instruction does not exist in the PLC itself.

The Macro instruction has three operands: source operand (S1), destination operand #1 (D1), and destination operand #2 (D2).



The source operand specifies the 16-bit word data to be processed by the Macro instruction. It can be entered with two types of data: the Constant (Character) and the Constant (Hexadecimal).

The constant (character) can be any character on the keyboard (ASCII character). The constant (hex decimal) can be any hex code. The constant (hex decimal) also includes all ENQ characters of the American National Standard Institute (ANSI), i.e. 0X00 to 0XFF.

The destination operand specifies the 16-bit word data to store the result of the Macro instruction. The destination operand #1 (D1) serves as the beginning of the data register, while destination operand #2 (D2) serves as the ending of the data register. When D1 is set, the Macro instruction looks at the length of S1 to set D2. The user does not set D2; it is set by the Macro instruction.



Complete the fields as displayed below in the field descriptions.

Once the dialog box is complete, click the **OK** button to activate the macro instruction on your ladder. To back out of this instruction without utilizing the Macro instruction, click the **Cancel** button.

To access on-line help, click the **Help** button.

Type:

The **Macro** instruction remains selected in the **Type:** field.

S1

When set up, descriptions of the source operands display in the **S1** field. Clicking on any of these instructions displays the corresponding macro information.

To set up a new macro, click the **Insert** button. Refer to page 9-201 for more information.



D1

Originally, when no instructions are entered, only one white field displays below the **D1** field. Destination operand #1 (D1) serves as the beginning of the data register. When D1 is set, the Macro instruction looks at the length of S1 to set D2.

Once information is entered in the **D1** field or once an instruction is selected from the **S1** field, two more white fields display below the **D1** instruction. The middle field displays the allocation number of D1. Enter a tag name in the lower field.

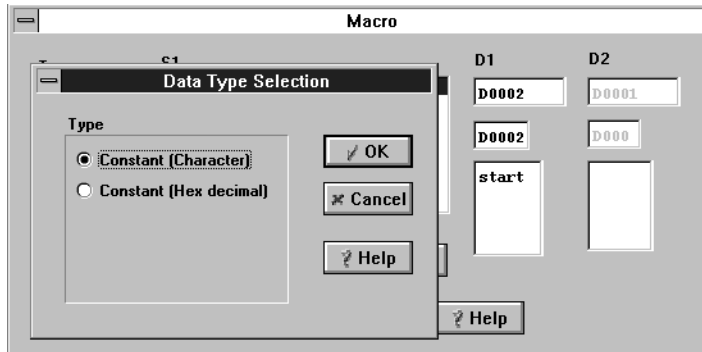
D2

Originally, when no instructions are entered, only one white field displays below the **D2** field. Destination operand #2 (D2) serves as the ending of the data register. Once information is entered in the **D1** field or once an instruction is selected from the **S1** field, then the corresponding information displays in the **D2** field.



Insert

To create a new macro, click the **Insert** button. The **Data Type Selection** dialog box will display.



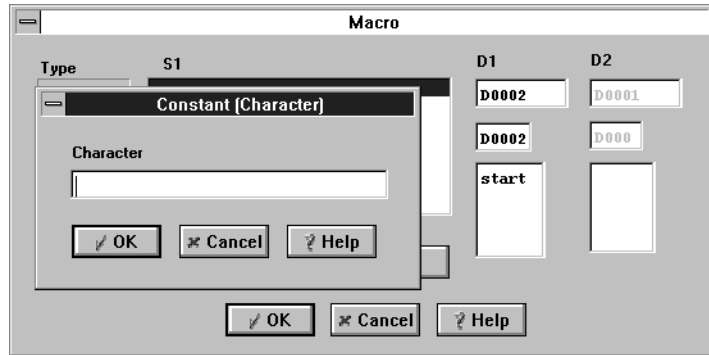
In the **Type:** field, click the circle to the left of the desired option: either **Constant [Character]** or **Constant [Hex decimal]**.

Once the dialog box is complete, click the **OK** button to save the data type. To back out of this dialog box without selecting a data type, click the **Cancel** button.

To access on-line help, click the **Help** button.

The logo for IDEC Corporation, consisting of the lowercase letters 'idec' in a bold, sans-serif font.

Once an instruction is selected in the **Type**: field and the **OK** button is pressed, the **Constant [Character]** dialog box will display.



If the **Constant [Character]** option is selected from the **Data Type Selection** dialog box, then the **Character** field will display.

If the **Constant [Hex decimal]** option is selected from the **Data Type Selection** dialog box, then the **Hex decimal** field will display.



In the **Character** field, enter the constant character string which will display in the **S1** field of the **Macro** dialog box. In the **Hex decimal** field, enter the constant hex decimal string which will display in the **S1** field of the **Macro** dialog box.

Once the dialog box is complete, click the **OK** button to save the data. To back out of this dialog box without selecting data, click the **Cancel** button.

To access on-line help, click the **Help** button.

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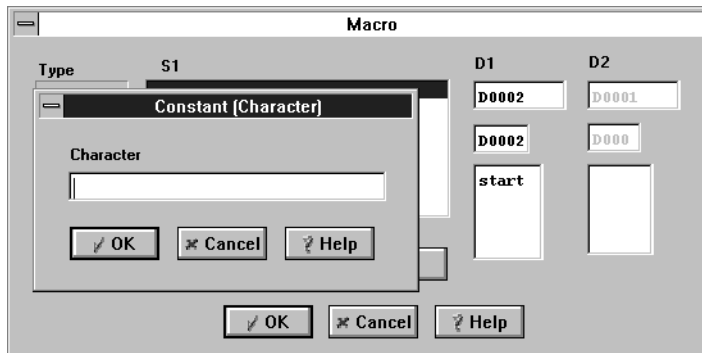
Delete

Use the **Delete** button to remove a macro instruction. Within the **S1** field, click the option to be deleted. Once the appropriate option is highlighted, click the **Delete** button. The macro instruction will no longer display in the **S1** field or in the database.

Edit

To edit an existing macro, click the **Insert** button.

If an option is selected within the **S1** field when the **Edit** button is clicked, then the **Constant [Character]** dialog box will display.



If the **Constant [Character]** option was selected originally from the **Data Type Selection** dialog box, then the **Character** field will display.

If the **Constant [Hex decimal]** option was selected originally from the **Data Type Selection** dialog box, then the **Hex decimal** field will display.

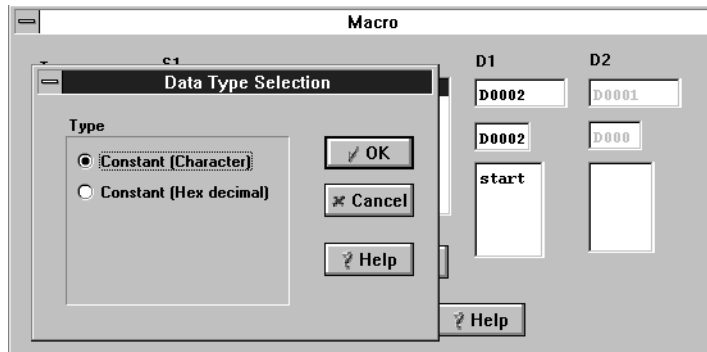


In the **Character** field, enter the character data which will display in the **S1** field of the **Macro** dialog box. In the **Hex decimal** field, enter the hex decimal data which will display in the **S1** field of the **Macro** dialog box.

Once the dialog box is complete, click the **OK** button to save the data type. To back out of this dialog box without selecting a data type, click the **Cancel** button.

To access on-line help, click the **Help** button.

If no option was selected within the **S1** field when the **Edit** button is clicked, then the **Data Type Selection** dialog box will display.



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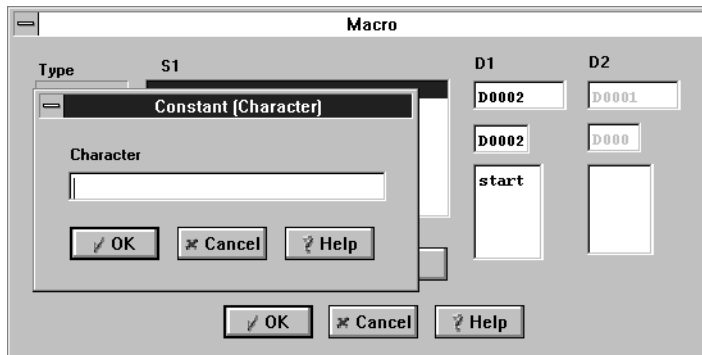


In the **Type:** field, click the circle to the left of the desired option: either **Constant [Character]** or **Constant [Hex decimal]**.

Once the dialog box is complete, click the **OK** button to save the data type. To back out of this dialog box without selecting a data type, click the **Cancel** button.

To access on-line help, click the **Help** button.

Once an option is selected in the **Type:** field and the **OK** button is pressed, the **Constant [Character]** dialog box will display.



If the **Constant [Character]** option was selected originally from the **Data Type Selection** dialog box, then the **Character** field will display.

If the **Constant [Hex decimal]** option was selected originally from the **Data Type Selection** dialog box, then the **Hex decimal** field will display.





In the **Character** field, enter the character data which will display in the **S1** field of the **Macro** dialog box. In the **Hex decimal** field, enter the hex decimal data which will display in the **S1** field of the **Macro** dialog box.

Once the dialog box is complete, click the **OK** button to save the data. To back out of this dialog box without selecting data, click the **Cancel** button.

To access on-line help, click the **Help** button.

***Right Mouse* → Advanced Instructions → No Operation (NOP)**

Selecting **Advanced Instructions → No Operation (NOP) →** literally programs a rung to have no operation. No operands can be programmed for the NOP instruction.

The NOP instruction may serve as a place-holder. Another use would be to add a delay to the Micro³ or Micro³C scan time, in order to simulate communication with a machine or application, for debugging purposes.

***Right Mouse* → Insert**

Selecting **Insert →** adds a ladder line, column, or rung before the current rung in your ladder program.



Click on the position before which you wish to insert the ladder instruction. A gray box will highlight this area.

Then, select **Insert → Ladder Line** to add a ladder line before the area which is highlighted by the gray box. Select **Insert → Column** to add a column before the area which is highlighted by the gray box. Select **Insert → Rung** to add a rung before the area which is highlighted by the gray box.

Right Mouse → Append

Selecting **Advanced Instructions → Append →** adds an attached ladder line, column, or rung after the current rung in your ladder program.

Click on the position after which you wish to append the ladder instruction. A gray box will highlight this area.

Then, select **Append → Ladder Line** to add a ladder line after the area which is highlighted by the gray box. Select **Append → Column** to add a column after the area which is highlighted by the gray box. Select **Append → Rung** to add a rung after the area which is highlighted by the gray box.

Right Mouse → Delete

Selecting **Delete →** removes a ladder line, column, or rung from your ladder program.

Click on the position which you wish to delete the ladder instruction. A gray box will highlight this area.

Then, select **Delete → Ladder Line** to remove the ladder line which is highlighted by the gray box. Select **Delete → Column** to remove the column which is highlighted by the gray box. Select **Delete → Rung** to remove the rung which is highlighted by the gray box.



Right Mouse → Split Rung

Selecting **Split Rung** separates two rungs of your ladder program.

Within your ladder program, click on the *lower* of the two ladder rungs which you wish to separate. A gray box will highlight this area. Then select **Split Rung** to separates these two rungs.

Right Mouse → Join Rung

Selecting **Join Rung** connects two rung of your ladder program.

Within your ladder program, click on the *upper* of the two ladder rungs which you wish to join. A gray box will highlight this area. Then select **Join Rung** to connect these two rungs.

Right Mouse → Disable Rung

Selecting **Disable Rung** makes the functionality of the rung latent. The instructions will remain visible on the rung; however, its function will be disabled.

Within your ladder program, click on the rung of the ladder which you wish to disable. A gray box will highlight this area. Then select **Disable Rung**.

Disabled rungs appear gray on the ladder diagram.



10. TRANSMIT/RECEIVE

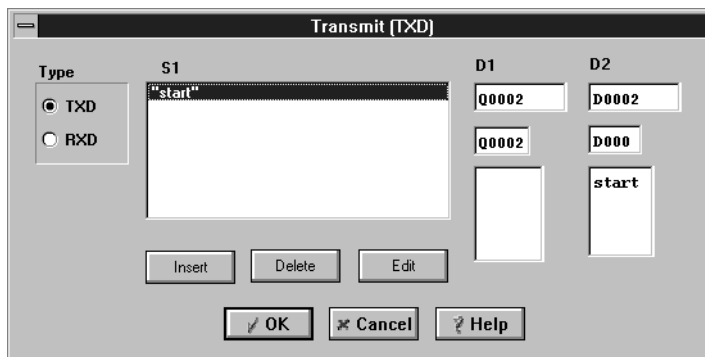
This chapter describes the programming of the transmit (TXD) instruction and receive (RXD) instruction for user communication.

NOTE: This instruction is only available for the Micro³C PLC.

With the protocol selector switch set to 1 or 3 to select the user protocol for the loader port, the Micro³C can transmit data using the TXD instruction through the loader port to an RS232C remote terminal, such as a computer, printer, or modem.

The Micro³C can also receive data through the loader port from a remote terminal with an RS232C port. The received data is converted and stored in data registers as designated by the RXD instruction.

To access the **Transmit/Receive** instruction, click the toolbar button:



idec



Complete the fields as explained below in the field descriptions.

Once the dialog box is complete, click the **OK** button to insert the transmit or receive instruction on your ladder. To back out of this dialog box without utilizing the transmit or receive instruction, click the **Cancel** button.

To access on-line help, click the **Help** button.

Type

Click the circle to the left of the desired option: either **TXD** for the transmit instruction or **RXD** for the receive instruction.

S1

Originally, when no options are entered, only the blank tag name field displays below the **S1** field. When set up, descriptions of the source operands display in the **S1** field. Clicking on any of these options displays the corresponding transmit or receive information. Transmit data designated by operand **S1** can be a maximum of 200 bytes.

To add a new source operand, click the **Insert** button. Refer to page 10-4 for complete instructions.

D1

Originally, when no options are entered, only the blank tag name field displays below the **D1** field. When transmission is complete, an output or internal relay designated by operand **D1** is turned on.



Once information is entered in the tag name field, the allocation number field and the tag name comment fields display below the **D1** option. The middle field displays the allocation number of D1. Optionally, enter a tag name description in the lower field.

D2

Originally, when no options are entered, only the blank tag name field displays below the **D2** field.

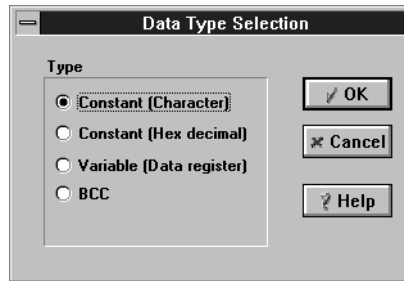
Once information is entered in the tag name field, the allocation number field and the tag name comment field display below the **D2** option. The middle field displays the allocation number of D2. Optionally, enter a tag name description in the lower field.

Destination 2 occupies two consecutive data registers, starting with the operand designated by D2. The transmit status data register, designated by D2, stores the status of the transmission and the error code. The next data register stores the byte count of transmitted data. The same data registers cannot be used as transmit status data registers for TXD instructions and for receive status data registers for RXD instructions. If the same data register numbers are programmed as status data registers for TXD and RXD instructions, syntax error 80 will result.



Insert

To create a new transmit or receive instruction, click the **Insert** button. The **Data Type Selection** dialog box will display.



In the **Type** field, click the circle to the left of the desired option: either **Constant [Character]**, **Constant [Hex decimal]**, **Variable [Data register]**, or **BCC**.

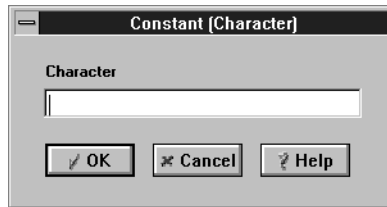
Once the dialog box is complete, click the **OK** button to save the data type. To back out of this dialog box without selecting a data type, click the **Cancel** button.

To access on-line help, click the **Help** button.

If the **Constant [Character]** option is selected in the **Type** field of the **Data Type Selection** dialog box, then the **Character** field will display in the **Constant [Character]** dialog box.

If the **Constant [Hex decimal]** option is selected in the **Type** field of the **Data Type Selection** dialog box, then the **Hex decimal** field will display in the **Constant [Character]** dialog box.

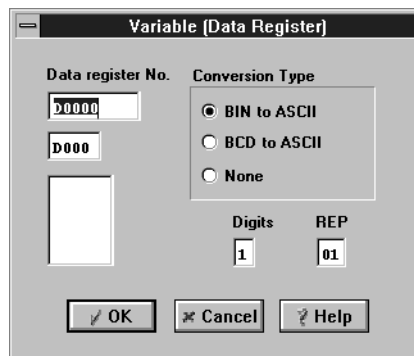




In the **Character** or **Hex decimal** field, enter the character data which will display in the S1 field of the **Transmit [TXD]** dialog box.

Once the dialog box is complete, click the **OK** button to save the data. To back out of this dialog box without selecting a data, click the **Cancel** button.

If the **Variable [Data register]** option is selected in the **Type** field of the **Data Type Selection** dialog box, then the **Variable [Data register]** dialog box will display.





Enter the tag name (or *nickname*) in the upper **Data register No.** field. Then, enter the allocation number in the middle field.

Optionally, enter any associated comments in the lower field. This reference may be a maximum of six characters per line for a maximum of four lines.

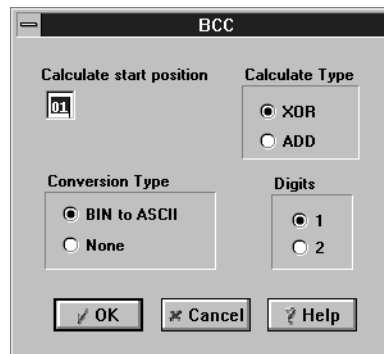
Click the circle to the left of the appropriate **Conversion Type** option: either **BIN to ASCII**, **BCD to ASCII**, or **None**.

Enter the number of digits to convert in the **Digits** field. Finally, enter the number of repeats for this variable in the **REP** field.

Once the dialog box is complete, click the **OK** button to save the variable. To back out of this dialog box without selecting a variable, click the **Cancel** button.

To access on-line help, click the **Help** button.

If the **BCC** option is selected in the **Type** field of the **Data Type Selection** dialog box, then the **BCC** dialog box will display.



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Enter the first character to be read in the **Calculate start position** field. Then, click the circle to the left of the appropriate **Calculate Type** option: either **XOR** for exclusive OR or **ADD** for addition.

Click the circle to the left of the appropriate **Conversion Type** option: either **BIN to ASCII** or **None**.

Finally, click the circle to the left of either **1** or **2** in the **Digits** field to determine the number of bytes that will be considered in the BCC calculation.

Once the dialog box is complete, click the **OK** button to save the BCC instruction. To back out of this dialog box without selecting a BCC instruction, click the **Cancel** button.

To access on-line help, click the **Help** button.

Delete

Use the **Delete** button to remove a transmit or receive instruction.

Within the **S1** field, click the option to be deleted. Once the appropriate option is highlighted, click the **Delete** button. The transmit or receive instruction will no longer display in the **S1** field.

Edit

To edit an existing transmit or receive instruction, click the **Edit** button.

Within the **S1** field, click the option to be edited. Once the appropriate option is highlighted, click the **Edit** button. Then, the corresponding dialog box will display.



For the steps associated with the **Constant** [Character] dialog box, refer to page 10-4. For the steps associated with the **Variable** [Data register] dialog box, refer to page 10-5. For the steps associated with the **BCC** dialog box, refer to page 10-6.

Transmit (TXD)



Valid Operands (Standard Processing)

Operand	S1 (Source 1)	D1 (Destination 1)	D2 (Destination 2)
Function	Transmit data	Transmit completion output	Transmit status
I	—	—	—
Q	—	0–31	—
M	—	0–287	—
T	—	—	—
C	—	—	—
R	—	—	—
D	0–498	—	0–497
Constant	00h–FFh	—	—
Repeat	0–99	—	—

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Transmit data, designated by operand S1, can be a maximum of 200 bytes.

When transmission is complete, the output or internal relay, designated by operand D1, is turned on.

Destination 2 occupies two consecutive data registers, starting with the operand designated by D2. The transmit status data register, designated by D2, stores the status of the transmission and the error code. The next data register stores the byte count of transmitted data. The same data registers cannot be used as transmit status data registers for TXD instructions and for receive status data registers for RXD instructions. If the same data register numbers are programmed as status data registers for TXD and RXD instructions, syntax error 80 will result.

Precautions for Programming TXD Instruction

- The Micro³C has five formatting areas for executing TXD instructions. Thus, more than five TXD instructions cannot be executed at the same time. An error code is set to the transmit status data register, designated by operand D2, in all excessive TXD instructions and cannot be executed.
- If the input for a TXD instruction is turned on while another TXD instruction is executed, then the subsequent transmit instruction is executed two scan times after the preceding TXD instruction is completed.
- Since TXD instructions are executed in each scan while an input is on, a pulse input from an SOTU or SOTD instruction should be used as required.
- In the high-speed processing mode, user communication instructions TXD and RXD cannot be used.



Transmit Data

Transmit data is designated by source operand S1 using constant values or data registers. BCC codes can also be calculated automatically and appended to the transmit data. One TXD instruction can transmit 200 bytes of data at the maximum.

S1 (Source 1)

Transmit Data	Operand	Conversion Type	Transmit Digits (Bytes)	Notes
Constant	00h–FFh (7Fh)	No conversion	1	—
Data Register	D0–D498	Binary to ASCII	1–4	1–99 repeat
		Binary to BCD to ASCII	1–5	
		No conversion	1–2	
BCC	—	Binary to ASCII	1–2	XOR calculation ADD calculation 1–15 calculation start position
		No conversion	1–2	



Designating Constant as S1

When a constant value is designated as source operand S1, one-byte data is transmitted without conversion. The valid transmit data value depends on the data bits selected in the FUN8 loader port communication mode setting. When eight data bits are selected, 00h–FFh is transmitted. When seven data bits are selected as the default, 00h–7Fh is transmitted. Constant values are entered in hexadecimal notation into the source data.

Designating Data Register as S1

When a data register is designated as source operand S1, conversion types and transmit digits must also be designated. The data stored in the designated data register is converted, and a designated quantity of digits of the resulting data is transmitted. Conversion types are available in binary to ASCII, binary to BCD to ASCII, and no conversion.

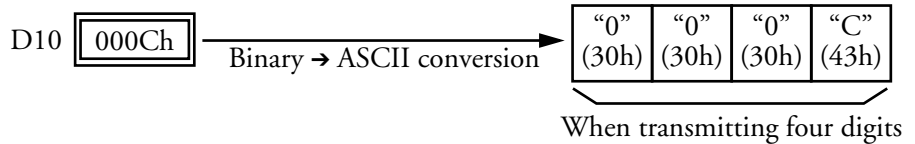
When a repeat is designated, the data of as many data registers as repeat cycles are transmitted, starting with the designated data register. Up to 99 repeat cycles can be used.



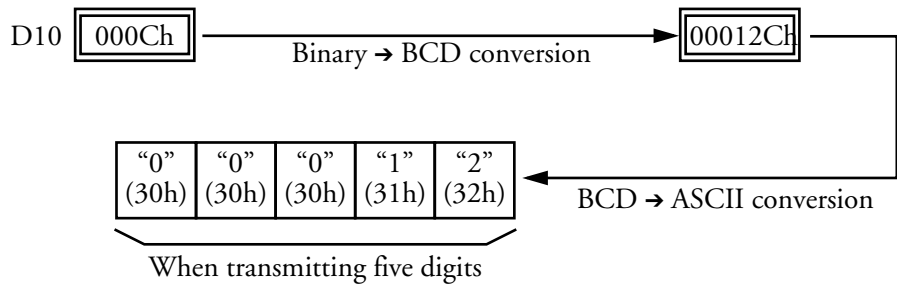
Conversion Type

The transmit data is converted according to the designated conversion type as described below.

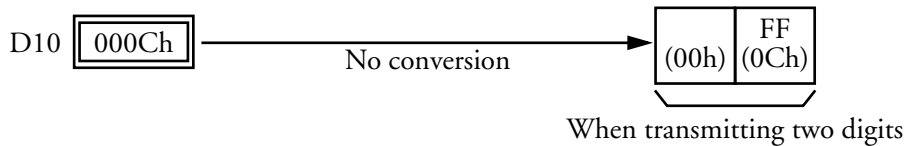
1. Binary → ASCII conversion



2. Binary → BCD → ASCII conversion



3. No conversion

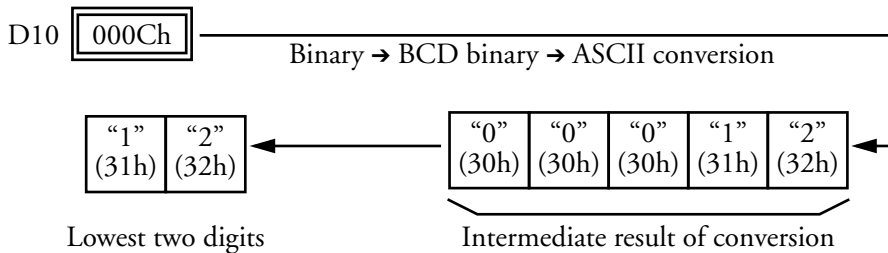


Transmit Digits (Bytes)

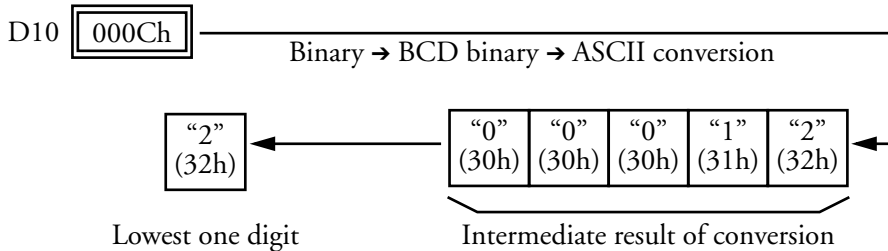
After conversion, the transmit data is taken out in specified digits. Possible digits depend on the selected conversion type.

Example: D10 stores 000Ch (12) and is converted in binary to BCD to ASCII

1. Transmit Digits = 2



2. Transmit Digits = 1



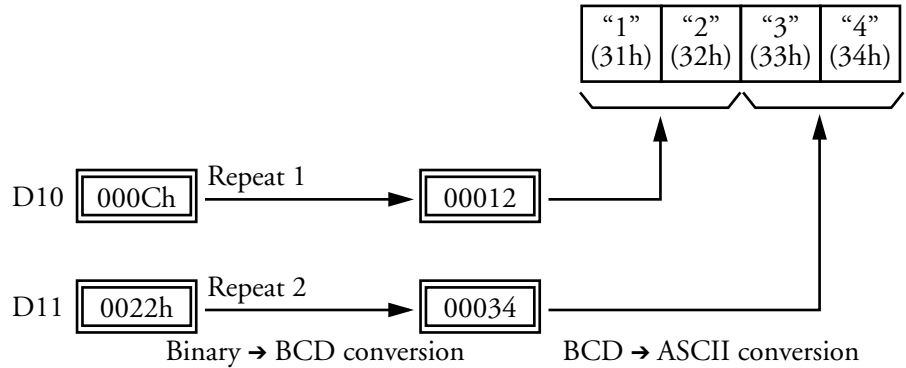
Repeat Cycles

When a data register is designated with a repeat, as many consecutive data registers as repeat cycles are used for the transmit data in the same conversion type and transmit digits.

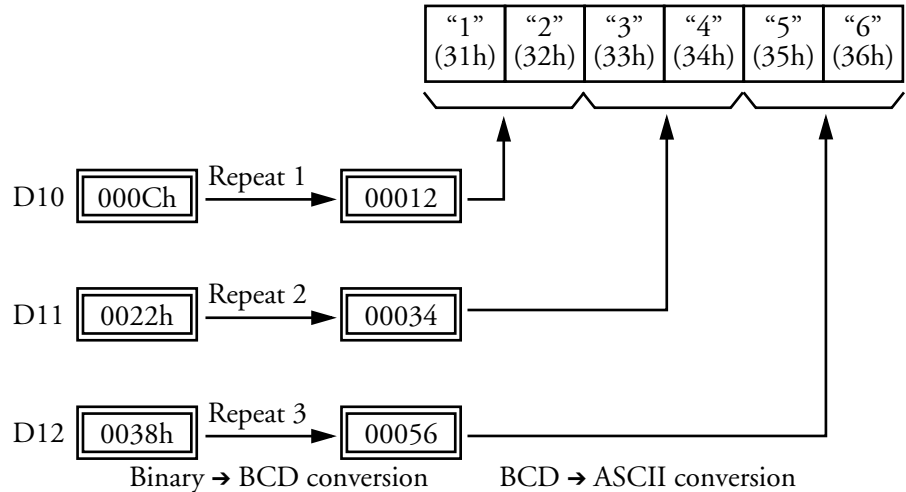


Example: Data register D10 is converted by binary to BCD to ASCII and is designated with two transmit digits.

1. Repeat Cycles = 2



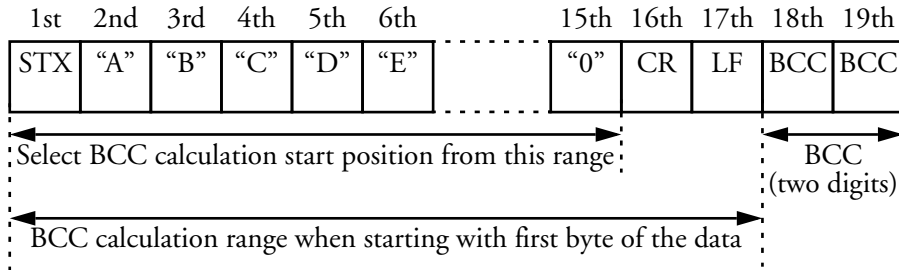
2. Repeat Cycles = 3



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Block Check Character (BCC)

Block check characters can be appended to the transmit data. The start position for the BCC calculation can be specified from the first byte through 15th byte. The BCC, calculated in either XOR or ADD, can be one or two digits.

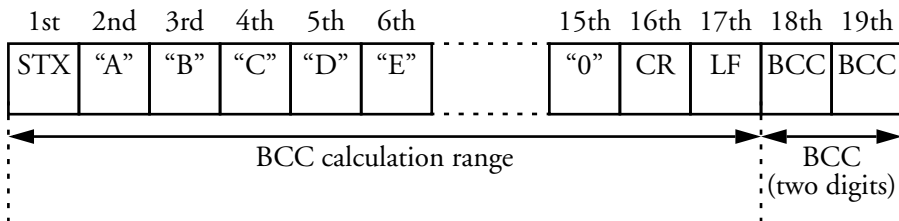


BCC Calculation Start Position

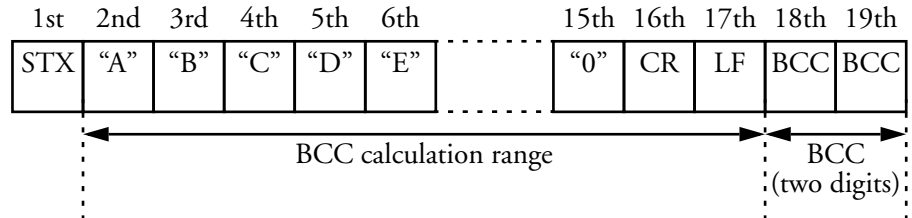
The start position for the BCC calculation can be specified from the first byte through fifteenth byte. The BCC is calculated for the range starting from the designated position up to the byte immediately before the BCC of the transmit data.

Example: Transmit data consists of 17 bytes plus two BCC digits.

1. Calculation Start Position = 1




2. Calculation Start Position = 2



BCC Calculation Formula

The BCC calculation formula can be selected from the exclusive OR (XOR) or addition (ADD) operation.

Example: Conversion results of transmit data consist of 41h, 42h, 43h, 44h, and 45h.

1. BCC Calculation Formula = XOR

$$41h + 42h + 43h + 44h + 45h = 41h$$

2. BCC Calculation Formula = ADD

$$41h + 42h + 43h + 44h + 45h = 14Fh \text{ to } 4Fh$$

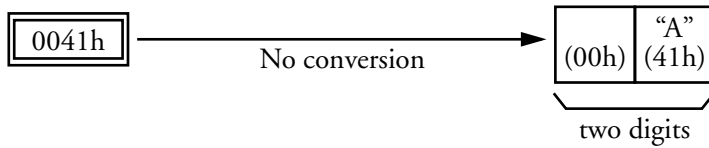
(Only last one or two digits are used as BCC.)

Conversion Type

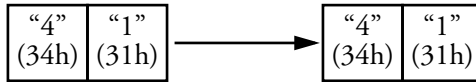
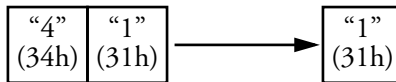
The result of a BCC calculation can be converted or not converted, according to the designated conversion type as described below.

Example: BCC calculation result is 0041h.



1. Binary → ASCII conversion**2. No conversion*****BCC Digits (Bytes)***

The quantity of digits (bytes) of the BCC code can be selected from 1 or 2.

Example:**1. BCC Digits = 2****2. BCC Digits = 1*****Transmit Completion Output***

Designate an output, Q0 through Q31, or internal relay, M0 through M287, as an operand for the transmit completion output.

When the start input for a TXD instruction is turned on, preparation for transmission is initiated, followed by data transmission. When the sequence of all transmission operations is complete, the designated output or internal relay is turned on.

Transmit Status

Designate a data register, D0 through D497, as the operand to store the transmit status information, including a transmission status code and a user communication error code.

To view the transmit status, monitor the designated data register in hexadecimal notation on the program loader.

Transmission Status Code

Code	Status	Description
1	Preparing transmission	From the point when the start input for a TXD instruction is turned on, until the transmit data is stored in the internal transmit buffer
2	Transmitting data	From the point when the data transmission is enabled by an END processing, until all data transmission is completed
3	Data transmission complete	From the point that all data transmission is completed, until the END processing is completed for the TXD instruction
4	Transmit instruction complete	From the point that all transmission operation is complete, until the next transmission is possible



If data transmission is aborted by an error, then remove the cause of the error and turn the start input for the TXD instruction on again. For error codes and causes, refer to *Appendix III: PLC Error Codes*.

Transmit Data Byte Count

The data register next to the operand is designated for the transmit status and stores the byte count of data transmitted by the TXD instruction. When BCC is included in the transmit data, the byte count of the BCC is also included in the transmit data byte count.

Receive (RXD)



When an input is on, the data received through the loader port of a remote terminal with an RS232C port is converted and stored in data registers according to the receive format designated by S1.

Valid Operands (Standard Processing)

Operand	S1 (Source 1)	D1 (Destination 1)	D2 (Destination 2)
Function	Receive data	Receive completion output	Receive status
I	—	—	—
Q	—	0–31	—
M	—	0–287	—

T	—	—	—
C	—	—	—
R	—	—	—
D	0–498	—	0–497
Constant	00h–FFh	—	—
Repeat	0–99	—	—

The receive format designated by operand S1 can be a maximum of 200 bytes.

When data is completely received, the output or internal relay, designated by operand D1, is turned on.

Destination 2 occupies two consecutive data registers starting with the operand designated by D2. The receive status data register, designated by D2, stores the status of the data received and the error code. The next data register stores the byte count of received data. The same data registers cannot be used as both transmit status data registers for TXD instructions and receive status data registers for RXD instructions. If the same data register numbers are programmed as status data registers for TXD and RXD instructions, syntax error 80 will result.

Precautions for Programming RXD Instruction

- The Micro³C can execute a maximum of five RXD instructions that have a start delimiter at the same time. If a start delimiter is not programmed in RXD instructions, then the Micro³C can execute only one receive instruction at a time. If the start input for an RXD instruction is turned on while another RXD instruction without a start delimiter is executed, then a user communication error occurs.



- Since RXD instructions are executed in each scan while an input is on, a pulse input from an SOTU or SOTD instruction should be used as required.
- In the high-speed processing mode, user communication instructions RXD and TXD cannot be used.

Receive Format

The receive format, designated by source operand S1, specifies data registers to store received data, data digits for storing data, data conversion type, and repeat cycles. A start delimiter and an end delimiter can be included in the receive format to discriminate valid incoming communication. When some characters in the received data are not needed, the *skip* can be used to ignore a specified number of characters. BCC code can also be appended to the receive format to verify the received data. One RXD instruction can receive 200 bytes of data at the maximum.

S1 (Source 1)

Receive Format	Operand	Conversion Type	Receive Digits (Bytes)	Notes
Data Register	D0–D498	ASCII to binary	1–4	1–99 repeat
		ASCII to BCD to binary	1–5	
		No conversion	1–2	
Start Delimiter	00h–FFh (7Fh)	No conversion	1	—



End Delimiter	00h–FFh (7Fh)	No conversion	1	—
BCC	—	Binary to ASCII	1–2	XOR calculation 1–15 calculation start position
		No conversion		ADD calculation
Skip	—	—	—	1–99 skip bytes

Designating Data Register as S1

When a data register is designated as source operand S1, receive digits and conversion types must also be designated. The received data is divided into a block of specified receive digits, converted in a specified conversion type, and stored in the designated data register. Conversion types are available in ASCII to binary, ASCII to BCD to binary, and no conversion.

When a repeat is designated, received data is divided, converted, and stored in as many data registers as repeat cycles, starting with the designated data register. Up to 99 repeat cycles can be used.

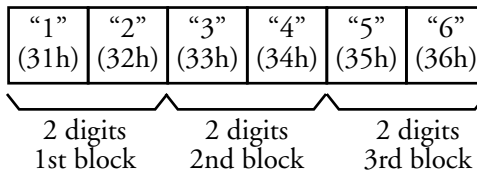


Receive Digits

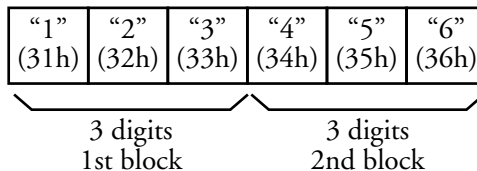
The received data is divided into a block of specified receive digits before conversion as described below.

Example: Received data of six bytes are divided in different receive digits. (A repeat is also designated.)

1. Receive Digits = 2



2. Receive Digits = 3

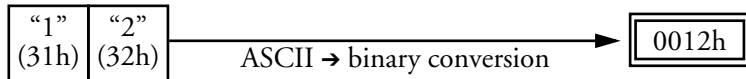


Conversion Type

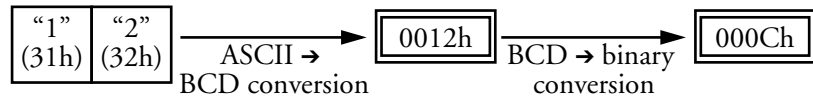
The data block of the specified receive digits is then converted according to the designated conversion type as described below.

Example: Received data has been divided into a two-digit block.

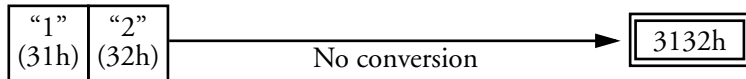
1. ASCII → binary conversion



2. ASCII → BCD → binary conversion



1. ASCII → binary conversion

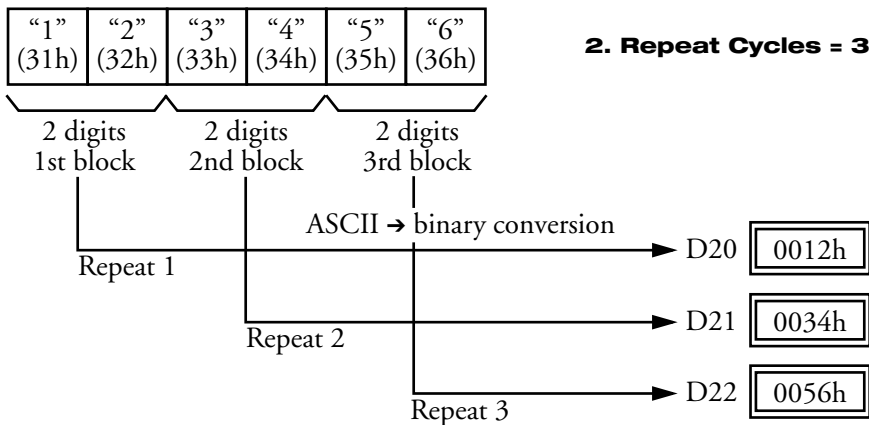
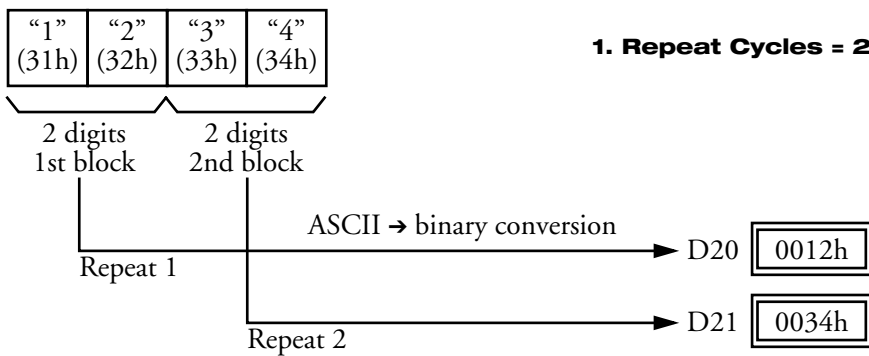


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Repeat Cycles

When a data register is designated with a repeat, the received data is divided and converted in the same way as specified. The converted data is stored in as many consecutive data registers as repeat cycles.

Example: Received data of 6 bytes is divided into two-digit blocks, converted in ASCII → binary, and stored to data registers starting at D20.



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Designating a Constant as a Start Delimiter

A start delimiter can be programmed at the first byte in the receive format of an RXD instruction. This way the Micro³C can recognize the beginning of valid communication; although, an RXD instruction without a start delimiter can also be executed.

When a constant value is designated at the first byte of source operand S1, the one-byte data serves as a start delimiter to start the processing of the received data. The valid start delimiter value depends on the data bits selected in the FUN8 loader port communication mode setting. When eight data bits are selected, start delimiters can be 00h–FFh. When seven data bits are selected as default, start delimiters can be 00h–7Fh. Constant values are entered in hexadecimal notation into the source data.

A maximum of five RXD instructions with different start delimiters can be executed at the same time. When the first byte of the incoming data matches the start delimiter of an RXD instruction, the received data is processed and stored according to the receive format specified in the RXD instruction. If the first byte of the incoming data does not match the start delimiter of any RXD instruction that is executed, the Micro³C discards the incoming data and waits for the next communication.

While an RXD instruction without a start delimiter is executed, any incoming data is processed continuously according to the receive format. Only one RXD instruction without a start delimiter can be executed at a time. If start inputs to two or more RXD instructions without a start delimiter are turned on simultaneously, then the one at the smallest address is executed and the corresponding completion output is turned on.



Designating a Constant as an End Delimiter

Program an end delimiter anywhere other than the first byte in the receive format of an RXD instruction. The Micro³C will recognize the end of valid communication. Even so, RXD instructions without end delimiters can also be executed.

When a constant value is designated anywhere other than the first byte of source operand S1, the one-byte data serves as an end delimiter to end the processing of the received data. The valid end delimiter value depends on the data bits selected in the FUN8 loader port communication mode setting. When eight data bits are selected, end delimiters can be 00h–FFh. When seven data bits are selected as the default, end delimiters can be 00h–7Fh. Constant values are entered in hexadecimal notation into the source data.

If a character in the incoming data matches the end delimiter, then the RXD instruction stops receiving data at this point and starts the subsequent receive processing as specified. Even if a character matches the end delimiter at a position earlier than expected, the RXD instruction stops receiving data there.

If a BCC code is included in the receive format of an RXD instruction, then an end delimiter can be positioned immediately before or after the BCC code. If a data register or skip is designated between the BCC and the end delimiter, then correct receiving is not ensured.

When an RXD instruction without an end delimiter is executed, data receiving ends when the specified bytes of the data in the receive format, such as data registers and skips, have been received. In addition, data receiving ends when the interval between the incoming data characters exceeds the receive time-out value specified in the FUN8 loader port communication mode setting, whether the RXD has an end delimiter or not.

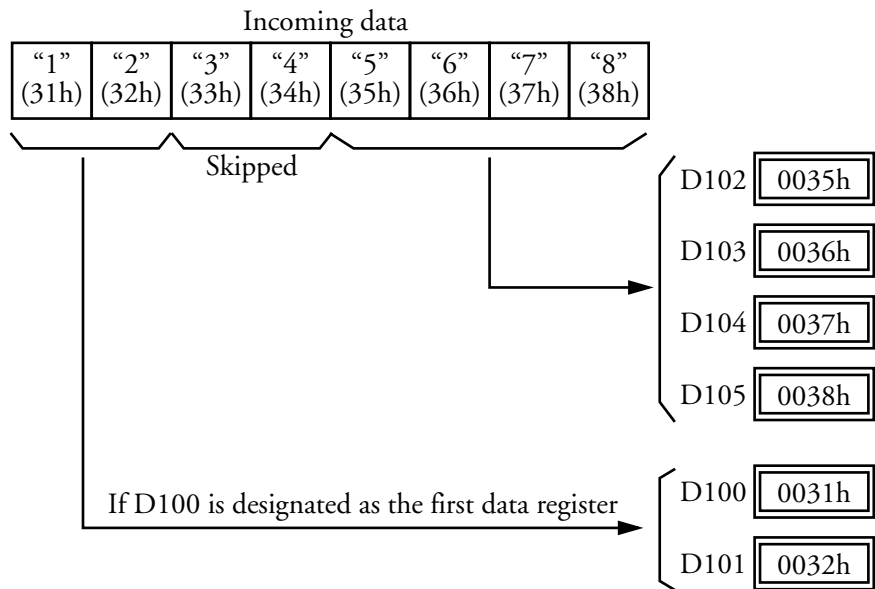


The character interval timer is started when the first character of incoming communication is received and restarted each time the next character is received. When a character is not received after a predetermined time, a time-out occurs and the RXD ends the data receive operation.

Skip

When a *skip* is designated in the receive format, a specified quantity of digits in the incoming data are skipped and, thus, not stored to data registers. A maximum of 99 digits (bytes) of characters can be skipped continuously.

Example: An RXD instruction with a two-digit skip starts at the third byte is executed.



Block Check Character (BCC)

The Micro³C has an automatic BCC calculation function to detect any communication error in incoming data. If a BCC code is designated in the receive format of an RXD instruction, then the Micro³C calculates a BCC value for a specified starting position through the position immediately preceding BCC. It then compares the calculation result with the BCC code in the received incoming data. The start position for the BCC calculation can be specified from the first byte through fifteenth byte. The BCC, calculated in either XOR or ADD, can be one or two digits.

When an end delimiter is not used in the RXD instruction, the BCC code must be positioned at the end of the receive format designated in the Source 1 (S1) operand. When an end delimiter is used, the BCC code must be immediately before or after the end delimiter. The Micro³C reads a specified number of BCC digits in the incoming data according to the receive format to calculate and compare the received BCC code with the BCC calculation results.

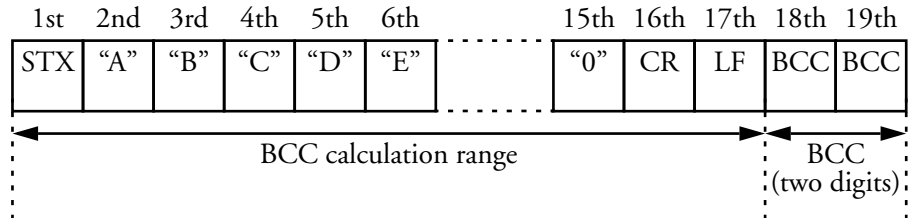
BCC Calculation Start Position

The start position for the BCC calculation can be specified from the first byte through fifteenth byte. The BCC is calculated for the range starting from the designated position up to the byte immediately before the BCC of the receive data.

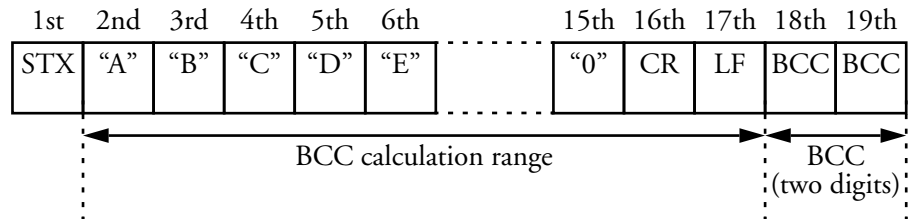


Example: Received data consists of 17 bytes plus two BCC digits.

1. Calculation Start Position = 1



2. Calculation Start Position = 2



BCC Calculation Formula

The BCC calculation formula can be selected from either the exclusive OR (XOR) or the addition (ADD) operation.

Example: Incoming data consist of 41h, 42h, 43h, 44h, and 45h.

1. BCC Calculation Formula = XOR

$$41h + 42h + 43h + 44h + 45h = 41h$$

2. BCC Calculation Formula = ADD

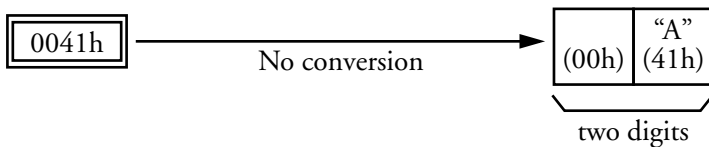
$$41h + 42h + 43h + 44h + 45h = 14Fh \text{ to } 4Fh$$

(Only last one or two digits are used as BCC.)

Conversion Type

The result of the BCC calculation can be converted (or not) according to the designated conversion type as described below.

Example: The result of the BCC calculation is 0041h.

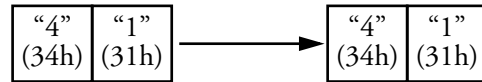
1. Binary → ASCII conversion**2. No conversion**

BCC Digits (Bytes)

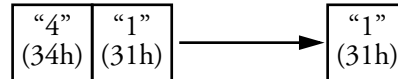
The quantity of digits (bytes) of the BCC code can be selected from 1 or 2.

Example:

1. BCC Digits = 2



2. BCC Digits = 1



Comparing BCC Codes

The Micro³C compares the BCC calculation result with the BCC code in the received incoming data. This checks for any errors in the incoming communication due to causes such as external noises. If a disparity is found in the comparison, then an error code is stored in the data register designated as receive status in the RXD instruction.

Receive Completion Output

Designate an output, Q0–Q31, or internal relay, M0–M287, as an operand for the receive completion output.

When the start input for an RXD instruction is turned on, preparation for receiving the data is initiated, followed by data conversion and storage. When all data is received, the designated output or internal relay is turned on.

idec

Receive Status

Designate a data register, D0–D497, as the operand to store the receive status information, including a receive status code and a user communication error code.

When the data register designated for the receive status is monitored in hexadecimal notation on the program loader, the second lowest digit indicates a receive status code and the lowest digit indicates a user communication error code. If no error exists, then the lowest digit indicates 0.

To view the receive status, monitor the designated data register in hexadecimal notation on the program loader.

Receive Status Code

Code	Status	Description
1	Preparing to receive data	From the point when the start input for an RXD instruction is turned on to read the receive format, until the RXD instruction is enabled by END processing
2	Receiving data	From the point when the RXD instruction is enabled by END processing, until incoming data is received
3	Data receive complete	From the point when incoming data is received, until the received data is converted and stored in data registers according to the receive format
4	Receive instruction complete	From the point when all data is received, until the next data receiving is possible



If data receiving is aborted by an error, then remove the cause of the error and turn the start input for the RXD instruction on again. For error codes and causes, refer to *Appendix III: PLC Error Codes*.

Receive Data Byte Count

The data register following the operand designated for the receive status stores the byte count of the data received by the RXD instruction. When a start delimiter, end delimiter, and BCC are included in the received data, the byte counts for these codes are also included in the receive data byte count.



APPENDIX 1: ALLOCATION NUMBERS

Micro-1 PLC

Allocation Table

Operand	Symbolic	Total Points
Adding Counter	C000–C044	45
Input	I000–I017	16
Internal Relay	M000–M197	160
Output	Q000–Q005, Q010–Q017	14
Reversible Counter	C045–C046	2
Shift Register	R000–R127	128
Single Output	0–95	96
Special Internal Relay	M200–M297, M300–M317	96
Timer	T000–T097	80

NOTE: Outputs Q006–Q007 (two points) cannot be used.

Outputs Q010–Q015 (six points) can be used with the expansion unit.

Outputs Q010–Q017 (eight points) can be used with the serial I/O module.

Special internal relays (M200–M287) are used for key matrix operations.



Micro-1 Special Internal Relays

Special internal relays are used to control certain conditions in the Micro-1 processor. In some cases, the special relays may be set after designating a value for a specified internal function or may be assigned after execution of the ladder logic program.

The following defines each of the Micro-1 PLC's special internal relays.

Symbolic	Numeric	Description
M200–M277	600–677	Sets the key matrix input on/off statuses. This is a read only register.
M280–M287	680–687	Sets the key matrix scan output. This is a read only register.
M290	690	Sets the short-pulse input status. This internal relay holds the short-pulse input status. Any short-pulse input (an input that has a pulse width of at least 0.5 milliseconds) received at input I0 is read and stored in this special internal relay. This is a read only register.
M291–M297	691–697	Unused
M300	700	Unused
M301–M302	701–702	Sets the start/stop control. These special internal relays can be used to start or stop the Micro-1 PLC.



M303	703	<p>Sets all outputs off.</p> <p>When this internal relay is turned on, all outputs Q0–Q5 and Q10–Q17 are turned off. Self-holding circuits using outputs Q0–Q5 and Q10–Q17 also are turned off and are not restored when M303 is turned off. Internal relays and shift registers remain unchanged.</p>
M304	704	<p>Sets the initialize pulse.</p> <p>When the Micro-1 starts operation, IR704 goes on for a period of one scan time.</p>
M305–312	705–712	Unused
M313	713	<p>Sets the clock reset (1 millisecond).</p> <p>When this internal relay is set, IR714, which generates clock pulses for timers, will be set to zero.</p>
M314	714	<p>Sets the internal 1 second clock.</p> <p>This is a one second clock. This special internal relay generates clock pulses for timers. The pulses oscillate at 500 millisecond on and 500 millisecond off. R714 will be on only if IR713 is off.</p> <p>This is a read only register.</p>



M315	715	Sets the internal 100 millisecond clock. This is a 100 millisecond clock. This special internal relay always generates clock pulses for timers. The pulses oscillate at 50 millisecond on and 50 millisecond off. R715 will be on only if IR713 is off. This is a read only register.
M316	716	Sets the TMR/CNT presets when modified. This special internal relay will be set when the timer/counter presets have been modified by the program loader or SFW30. This special internal relay will be reset when the control program is written (transferred) into the user memory. This is a read only register.
M311	711	Sets the RUN status. This special internal relay is always on when the processor is in the run mode. This is a read only register.



Micro³ Allocation Numbers

The Micro³ PLC is programmed using operands such as inputs, outputs, internal relays, timers, counters, shift registers, and data registers.

Option	Allocation	Function Description
Inputs	I	Receive input signals through the input terminals
Outputs	Q	Send the processed results of the user program to the output terminals
Internal Relays	M	Used in the Micro ³ ; cannot be output to the output terminals
Special Internal Relays	M	Dedicated to specific functions
Timers	T	Used in the user program; available in 100 msec, 10 msec, and 1 msec timers
Counters	C	Used in the user program; available in reversible counters and adding counters
Shift Registers	R	Registers to shift the data bits according to pulse inputs
Data Registers	D	Registers used to store numerical data; some are dedicated to special functions

Available I/O numbers depend on the type and combination of the Micro³ base units used in the expansion link system.



Allocation Table for the Micro³

Operand	Processing Mode	Allocation Number	Maximum Points
Input	Standard and high-speed	I0–I7 I10–I15	14 points (base) + 14 points (expansion)
	Standard only	I20–I27 I30–I35	14 points (base) + 14 points (expansion)
Output	Standard and high-speed	Q0–Q7 Q10–Q11	10 points (base) + 10 points (expansion)
	Standard only	Q20–Q27 Q30–Q31	10 points (base) + 10 points (expansion)
Internal Relay	Standard and high-speed	M0–M7 M10–M17 M20–M27 M30–M37 M40–M47	232 points (40 points)
	Standard only	M50–M57 M60–M67 M70–M77 M80–M87 M90–M97 M100–M107 M110–M117 M120–M127 M130–M137	232 points (40 points)



Internal Relay (continued)	Standard only	M140–M147	232 points (40 points)
		M150–M157	
		M160–M167	
		M170–M177	
		M180–M187	
		M190–M197	
		M200–M207	
		M210–M217	
		M220–M227	
		M230–M237	
		M240–M247	
		M250–M257	
		M260–M267	
		M270–M277	
M280–M287			
Catch Input Relay	Standard and high-speed	M290–M297	8 points (8 points)
Special Internal Relay	Standard and high-speed	M300–M307 M310–M317	16 points (16 points)
Timer	Standard and high-speed	T0–T15	32 points total (16 points total)
	Standard only	T16–T31	32 points total (16 points total)



Counter	Standard and high-speed	C0–C15	32 points total (16 points total)
	Standard only	C16–C31	32 points total (16 points total)
Shift Register	Standard and high-speed	R0–R31	64 points (32 points)
	Standard only	R32–R63	64 points (32 points)
Data Register	Standard and high-speed	D0–D31	100 points (32 points)
	Standard only	D32–D99	100 points (32 points)

NOTE: Input and output allocation numbers for the expansion station start with I20 and Q20. These input and output allocation numbers are not continuous between the base station and the expansion station in the expansion link system. The maximum points shown in () are values for the high-speed processing mode. The same number cannot be used for a counter and a timer in a user program.



Micro³ Special Internal Relays

IR Number	Function	Description
M301	Initialize Pulse	When Micro ³ starts operation, M301 turns on for a period of one scan.
M302	All Outputs OFF	When M302 is turned on, all outputs (Q0–Q31) go off until M302 is turned off. Self-maintaining circuits using outputs also go off and are not restored when M302 is turned off.
M303	Carry (Cy) and Borrow (Bw)	When a carry or borrow results from executing an addition or subtraction instruction, M303 turns on. M303 is also used for the bit shift and rotate instructions.
M304	User Program Execution Error	When an error occurs while executing a user program, M304 turns on.
M305	Link Communication Error	When an error occurs during communication in the expansion link system or in the data link system, M305 turns on. The M305 status is maintained when the error is cleared and remains on until M305 is reset using the program loader.



M306	Link Communication Prohibit Flag	When M306 is turned on at the base or master station in the expansion link system or the data link system, communication is stopped. The M306 status is maintained when Micro ³ is turned off and remains on until M306 is reset using the program loader.
M307	Link Communication Stop Flag	When a slave station does not receive communication data from the master station in the data link system for 800msec or more, M307 turns on. When the slave station receives correct communication data, M307 turns off.
M310	1 sec Clock Reset	When M310 is on, M311 (1 second clock) is reset to zero.
M311	1 sec Clock	When M310 is off, M311 generates clock pulses in 1 second increments, with a duty ratio of 1:1 (500 msec on and 500 msec off).
M312	100 msec Clock	M312 always generates clock pulses in 100 msec increments, whether M310 is on or off, with a duty ratio of 1:1 (50 msec on and 50 msec off).



M313	10 msec Clock	M313 always generates clock pulses in 10 msec increments, whether M310 is on or off, with a duty ratio of 1:1 (5 msec on and 5 msec off).
M314	Timer/ Counter Preset Value Changed	When timer or counter preset values are changed in the Micro ³ base unit RAM, M314 turns on. When a user program is transferred to Micro ³ or when the changed timer/counter preset value is cleared using FUN21, M314 turns off.
M315	High-Speed Counter Soft Reset	When M315 is turned on while a high-speed counter (HSC0, HSC1, HSC2, or HSC3) is used, the high-speed counter current value is reset to zero. When M315 is turned off, the high-speed counter restarts counting.
M316	High-Speed Counter (HSC3) Overflow	When the current value of high-speed counter HSC3 exceeds the maximum value of 65535, M316 is turned on. M316 is turned off when the high-speed counter is reset using the hard or soft reset input.
M317	In-Operation Output	M317 remains on while Micro ³ is running.



Micro³C Allocation Numbers

The Micro³C PLC is programmed using operands such as inputs, outputs, internal relays, timers, counters, shift registers, and data registers.

Option	Allocation	Function Description
Inputs	I	Relays to receive input signals through the input terminals
Outputs	Q	Relays to send the processed results of the user program to the output terminals
Internal Relays	M	Relays used in Micro ³ C; cannot be output to the output terminals
Special Internal Relays	M	Internal relays dedicated to specific functions
Timers	T	Relays used in the user program; available in 100-msec, 10-msec, and 1-msec timers
Counters	C	Relays used in the user program; available in reversible counters and adding counters
Shift Registers	R	Registers to shift the data bits according to pulse inputs
Data Registers	D	Registers used to store numerical data; some are dedicated to special functions



This section describes allocation numbers available only for Micro³C. For details about allocation numbers shared with the Micro³, refer to the *Allocation Table for the Micro³* on page A1- 6. The expanded functions available with the Micro³C include:

- The Micro³C has 500 data registers: D0–D499
- D499 is used to enable or disable the expansion control data registers D484–D498 and cannot be used as an ordinary data register to store data
- Special internal relay M307 has different functions when used as a base or expansion station in the expansion link system or when used as a master station or slave station in the data link system

Available I/O numbers depend on the type and combination of the Micro³C base units used in the expansion link system.



Allocation Table for the Micro³C

Operand	Processing Mode	Allocation Number	Maximum Points
Input	Standard and high-speed	I0–I7 I10–I15	14 points (base) + 14 points (expansion)
	Standard only	I20–I27 I30–I35	
Output	Standard and high-speed	Q0–Q7 Q10–Q11	10 points (base) + 10 points (expansion)
	Standard only	Q20–Q27 Q30–Q31	



Internal Relay	Standard and high-speed	M0–M7 M10–M17 M20–M27 M30–M37 M40–M47	232 points (40 points)
	Standard only	M50–M57 M60–M67 M70–M77 M80–M87 M90–M97 M100–M107 M110–M117 M120–M127 M130–M137 M140–M147 M150–M157 M160–M167 M170–M177 M180–M187 M190–M197 M200–M207 M210–M217 M220–M227 M230–M237 M240–M247 M250–M257 M260–M267	232 points (40 points)



Internal Relay (continued)	Standard only	M270–M277 M280–M287	232 points (40 points)
Catch Input Relay	Standard and high-speed	M290–M297	8 points (8 points)
Special Inter- nal Relay	Standard and high-speed	M300–M307 M310–M317	16 points (16 points)
Timer	Standard and high-speed	T0–T15	
	Standard only	T16–T31	32 points total (16 points total)
Counter	Standard and high-speed	C0–C15	
	Standard only	C16–C31	
Shift Register	Standard and high-speed	R0–R31	64 points (32 points)
	Standard only	R32–R63	
Data Register	Standard and high-speed	D0–D31	500 points (32 points)
	Standard only	D32–D499	



Micro³C I/O Allocation Numbers for Expansion Link System

Input and output allocation numbers do not continue from the base station to the expansion station. At the expansion station, inputs start at I20 and outputs start at Q20. Inputs and outputs are allocated depending on the Micro³C base units used in the expansion link system as shown below.

I/O Points Total	I/O Points In/Out	Micro³C Base Station I/O Allocation Numbers	Micro³C Expansion Station I/O Allocation Numbers
16	9/7	16 I/O Type I0–I7, I10, Q0–Q6	—
24	14/10	24 I/O Type I0–I7, I10–I15, Q0–Q7, Q10–Q11	—
32	18/14	16 I/O Type I0–I7, I10, Q0–Q6	16 I/O Type I20–I27, I30, Q20–Q26
40	23/17	16 I/O Type I0–I7, I10, Q0–Q6	24 I/O Type I20–I27, I30–I35, Q20–Q27, Q30–Q31
40	23/17	24 I/O Type I0–I7, I10–I15, Q0–Q7, Q10–Q11	16 I/O Type I20–I27, I30, Q20–Q26
48	28/20	24 I/O Type I0–I7, I10–I15, Q0–Q7, Q10–Q11	24 I/O Type I20–I27, I30–I35, Q20–Q27, Q30–Q31



Special Internal Relay Allocation Numbers

Internal relays M290 through M317 are special internal relays with the following functions.

Allocation Number	Description	CPU Stopped	Power OFF
M290	Catch input status set (see note)—Input I0	Operating	Cleared
M291	Catch input status set — Input I1	Operating	Cleared
M292	Catch input status set — Input I2	Operating	Cleared
M293	Catch input status set — Input I3	Operating	Cleared
M294	Catch input status set — Input I4	Operating	Cleared
M295	Catch input status set — Input I5	Operating	Cleared
M296	Catch input status set — Input I6	Operating	Cleared
M297	Catch input status set — Input I7	Operating	Cleared
M300	Start control	Maintained	Maintained
M301	Initialize pulse (see note)	Cleared	Cleared



M302	All outputs off	Cleared	Cleared
M303	Carry (Cy) or borrow (Bw)	Cleared	Cleared
M304	User program execution error	Cleared	Cleared
M305	Link communication error (expansion mode and data link mode)	Maintained	Cleared
M306	Link communication prohibit flag (expansion mode and data link mode)	Maintained	Maintained
M307	Link communication initialize flag (master station) (expansion mode and data link mode) Link communication stop flag (slave station) (expansion mode and data link mode) (details on page A1- 20)	Cleared	Cleared
M310	1 sec clock reset	Cleared	Cleared
M311	1 sec clock	Operating	Cleared
M312	100 msec clock	Operating	Cleared
M313	10 msec clock	Operating	Cleared



M314	Timer/counter preset value changed	Maintained	Maintained
M315	High-speed counter soft reset	Maintained	Cleared
M316	High-speed counter (HSC3) overflow	Cleared	Cleared
M317	In-operation output	Cleared	Cleared

NOTE: M290–M297 and M301 are used only for reading in the user program. However, these can be directly set or reset using the program loader or WindLDR.

**M307 Link Communication Initialize Flag (Master Station)/
Link Communication Stop Flag (Slave Station)**

Special internal relay M307 has different functions when used as a base or expansion station in the expansion link system or when used as a master station or slave station in the data link system.

Base or master station: Link communication initialize flag

When M307 at the base or master station is turned on during operation, the link configuration is checked to initialize the expansion or data link system. When an expansion station or slave station is powered up after the base or master station, turn M307 on to initialize the link system. After an expansion link or data link setup is changed, M307 must also be turned on to ensure correct communication.



Slave station: Link communication stop flag

When a slave station does not receive communication data from the master station for 800 msec or more in the data link system, M307 turns on. When the slave station receives correct communication data, M307 turns off. In the expansion station, M307 has no effect.

Data Register Allocation Numbers

Available data registers are limited in the high-speed processing mode or in the data link system configuration. Some data registers are allocated to special functions in the data link system as shown below. For the data link function, refer to the *Micro³ User's Manual*. D100–D209, D492, and D493 have special functions in the modem mode.

Standard Processing Mode

Data Register Number	Other than Data Link	Data Link (Master Station)	Data Link (Slave Station)	High-Speed Processing Mode
D0–D31	Available	Available	Available	Available
D32–D59	Available	Available	Available	Not available
D60–D84	Available	For data link	Available	Not available
D85–D89	Available	For data link	For data link	Not available
D90–D99	Can be designated as control data registers using FUN10 (note)			Not available
D100–D483	Available			Not available



D484– D485	<p>When expansion control data register service is enabled for each group of these data registers using D499, the selected data registers work as expansion control data registers; others can be used as ordinary data registers.</p> <p>When expansion control data register service is disabled using D499, these data registers can be used as ordinary data registers.</p>			Not available
D486– D491	See D484–D485			Not available
D492– D495	See D484–D485			Not available
D496– D498	See D484–D485			Not available
D499	Reserved to enable or disable expansion control data register service.			Not available

NOTE: When FUN10 is set to enable control data registers, selected data registers D90 through D99 work as control data registers; others can be used as ordinary data registers. For details of the data link function, see the *Micro³ User's Manual*.



Micro³C Expansion Control Data Registers

Data registers D484 through D499 are allocated as expansion control data registers. D499 is used to enable or disable expansion control data register service for D484 through D498 divided into group 0 through 3. The data registers in the group which are disabled for expansion control data registers can be used as ordinary data registers.

D499 cannot be used as an ordinary data register and must not be programmed to store the data of operation results.

Group	Expansion Control Data Register	Description
	D499	Expansion control data register service selection
0	D498	Day (calendar)
	D497	Month (calendar)
	D496	Year (calendar)
1	D495	Modem mode selection
	D494	Reserved
	D493	Modem mode status
	D492	Protocol selection in modem mode
2	D491	Control signal status
	D490	DSR control signal option; available only for communication through the loader port using user protocol (Protocol selector switch set to 1 or 3)



2	D489	DTR control signal option
	D488	RTS control signal option
	D487	Reserved
	D486	RTS control signal ON/OFF timer
3	D485 (Lower byte)	Protocol selector switch value
	D485 (Upper byte)	For maintenance
	D484 (Lower byte)	Function selector switch value
	D484 (Upper byte)	For maintenance

D499 Expansion Control Data Register Service Selection

D499 is used to enable or disable expansion control data register service for D484 through D498, divided into groups 0–3. Store a value in D499 to enable or disable expansion control data service for groups 0–3 as described below.

Group	D499 Value															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0		X		X		X		X		X		X		X		X
1			X	X			X	X			X	X			X	X
2					X	X	X	X					X	X	X	X
3									X	X	X	X	X	X	X	X



The D499 value marked with “X” indicates that the data registers in the corresponding group are enabled for the expansion control data register service. The enable/disable of expansion control data register service is determined by the lower four bits in D499. Although a value over 15 can be entered to D499, upper 12 bits do not take effect.

Group 0

D498 Day (calendar)

D497 Month (calendar)

D496 Year (calendar)

When group 0 is enabled as an expansion control data register, the calendar data is stored to D496 through D498. The year is indicated with the lower two digits.

Group 1

D495 Modem mode selection

When group 1 is enabled as expansion control data registers and 1 is entered for D495, the modem mode is enabled. When 0 is entered for D495, the modem mode is disabled.

D494 Reserved

D493 Modem mode status

When the modem mode is enabled (see above), D493 stores a modem mode status.

D493 Value	Description	Remarks
30h	AT command completed normally	AT command (start IR) is completed normally.
31h	Issuing AT command	



32h	AT command execution error	See the result code stored in data registers D104–D119. Check the modem power, modem cable, and the remote modem.
33h	Two or more start IRs are on	Correct the program so that only one start IR goes on at a time.
34h	Modem mode enabled	
35h	Start IR program error	Correct the program so that only the disconnect command is issued while the line is connected.
36h	Reserved	
37h	Reserved	
38h	Retrying AT command	
39h	AT command program error	Correct the program to include 0Dh in the AT command.

D492 Protocol selection in modem mode

When the modem mode is enabled (see above), the protocol at the loader port is switched from the user protocol depending on the value in D492 after the telephone line is connected.

D492 = 1	User protocol is continued at the loader port
D492 = 0	Loader protocol is enabled at the loader port



Group 2**D491 Control signal status**

When group 2 is enabled as the expansion control data registers, D491 stores a value to show that RTS, DSR, and DTR are on or off. The data of D491 is updated at every END processing.

D491 Value	RTS	DSR	DTR	Description
0	OFF	OFF	OFF	All RTS, DSR, and DTR are off
1	ON	OFF	OFF	RTS is on
2	OFF	ON	OFF	DSR is on
3	ON	ON	OFF	RTS and DSR are on
4	OFF	OFF	ON	DTR is on
5	ON	OFF	ON	RTS and DTR are on
6	OFF	ON	ON	DSR and DTR are on
7	ON	ON	ON	All RTS, DSR, and DTR are on

D490 DSR control signal option

When group 2 is enabled as the expansion control data registers, D490 is used to control data flow between the Micro³C and the remote terminal depending on the Data Set Ready (DSR) signal of the remote terminal. The DSR signal is an input to the Micro³C to determine the status of the remote terminal. The remote terminal informs the Micro³C using DSR whether the remote terminal is ready for receiving data or is sending valid data.



The DSR control signal option can be used only in the user protocol to communicate through the loader port.

D490 = 0	DSR is not used for data flow control. When DSR control is not needed, set 0 to D490. D490 = 0 is the system default.
D490 = 1	When DSR is on, the Micro ³ C can transmit and receive data.
D490 = 2	When DSR is off, the Micro ³ C can transmit and receive data.
D490 = 3	When DSR is on, the Micro ³ C can transmit data. This function is usually called <i>busy control</i> and is used for controlling transmission to a remote terminal with a slow processing speed, such as a printer. When the remote terminal is busy, data input to the remote terminal is restricted.
D490 = 4	When DSR is off, the Micro ³ C can transmit data. This function is contrary to D490 = 3.
D490 = 5	When DSR is on, the Micro ³ C can receive data.
D490 = 6	When DSR is off, the Micro ³ C can receive data.
D490 = 7+	Same as D490 = 0. DSR is not used for data flow control.



D489 DTR control signal option

When group 2 is the enabled as expansion control data registers, D489 is used to control the Data Terminal Ready (DTR) signal to indicate the Micro³C operating status or transmitting/receiving status.

The DTR control signal option can be used only in the user protocol to communicate through the loader port.

D489 = 0	While the Micro ³ C is running, DTR is on whether the Micro ³ is transmitting or receiving data. While the Micro ³ C is stopped, DTR remains off. Use this option to indicate the Micro ³ C operating status. D489 = 0 is the system default.
D489 = 1	While the Micro ³ C is transmitting data, DTR is turned on. While the Micro ³ C is not transmitting data, DTR remains off. Use this option when a remote terminal operates in the half-duplex mode since DTR goes on or off according to the transmit data from the Micro ³ C.
D489 = 2	While the Micro ³ C is transmitting data, DTR remains off. While the Micro ³ C is not transmitting data, DTR is turned on. The DTR operation at this option is contrary to the operation at D489 = 1.
D489 = 3	DTR remains off.



D489 = 4	While the Micro ³ C can receive data, DTR is turned on. Use this option when flow control of received data is required.
D489 = 5	DTR is turned on or off according to DSR. When DSR is on, DTR is turned on. When DSR is off, DTR remains off. Use this option for returning control signals and acknowledgment when data flow control with the remote terminal is required.
D489 = 6+	Same as D489 = 0.

D488 RTS control signal option

When group 2 is enabled as the expansion control data registers, D488 is used to control the Request to Send (RTS) signal to indicate the Micro³C transmitting/receiving status or operating status.

The RTS control signal option can be used only in the user protocol to communicate through the loader port.

D488 = 0	While the Micro ³ C is transmitting data, RTS remains off. While the Micro ³ C is not transmitting data, RTS is turned on. Use this option when a remote terminal operates in the half-duplex mode since RTS goes on or off according to the transmit data from the Micro ³ C. D488 = 0 is the system default.
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D488 = 1	While the Micro ³ C is transmitting data, RTS is turned on. While the Micro ³ C is not transmitting data, RTS remains off. Use this option when a remote terminal operates in the half-duplex mode since RTS goes on or off according to the transmit data from the Micro ³ C.
D488 = 2	While the Micro ³ C is running, RTS is on whether the Micro ³ C is transmitting or receiving data. While the Micro ³ C is stopped, RTS remains off. Use this option to indicate the Micro ³ C operating status.
D488 = 3	RTS remains off.
D488 = 4	While the Micro ³ C can receive data, RTS is turned on. Use this option when flow control of receive data is required.
D488 = 5	RTS is turned on or off according to DSR. When DSR is on, RTS is turned on. When DSR is off, RTS remains off. Use this option for returning control signal and acknowledgment when data flow control with the remote terminal is required.
D488 = 6+	Same as D488 = 0.
D487 Reserved	



D486 RTS control signal ON/OFF timer

When group 2 is enabled as the expansion control data registers and D488 is set to 0 or 1 to synchronize the transmit data with the RTS signal, D486 is used to set the amount of time to turn on and off the RTS signal before and after transmitting data.

The RTS control signal ON/OFF timer can be used only in the user protocol to communicate through the loader port.

D486 = 0-249 (Increments 10 msec)	Any value over 249 is regarded as 249. The maximum timer error is 20 msec + 2 scan time.
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Operating Status and Control Signals

Communication Mode	Micro³C Stopped	Micro³C Running
User Protocol	DTR and RTS are on, except DTR is off when D489 = 0 RTS is off when D488 = 2	Control signal statuses depend on D488 through D490 options
Modem Mode	DTR and RTS are on as standard	Initial settings are: D488 = 2, D489 = 0, D490 = 0
Loader Protocol	Control signal options have no effect Communication is executed with D488 = 0, D489 = 0, D490 = 0	



APPENDIX 2: ERROR CODES

General Error Codes

Error data for the Micro-1 can be checked in the **Online → PLC Status** dialog box in WindLDR. PLC error codes for the Micro³ or Micro³C may be registered on the PLC program loader or in the **PLC Status** dialog box in WindLDR.

When reading error data using FUN20, the error code is displayed using one, two, or three digits in hexadecimal notation (0–F). These hexadecimal codes consist of four items each in the first and second digits and two items in the third digit. Each digit of the error code indicates a different set of conditions requiring attention.

Each error code display indicates that the error marked with “X” has occurred. Two or more marks indicate that multiple errors have occurred at the same time.

If any of the conditions from the *First Digit Error Code* chart on page A3 - 2 exist (digit on the left), then this digit displays on the program loader. If conditions from both the *First Digit Error Code* chart or the *Second Digit Error Code* chart (on page A3 - 3) exist, then these two digits display.

For example, the error code may read out “21.” This indicates two conditions requiring attention: “User program sum check error” from the *Second Digit Error Code* chart and “Power failure” from the *Third Digit Error Code* chart. If the read-out displays “D,” then this indicates three conditions exist from only the *First Digit Error Code* chart.



When control data register D92 is enabled using FUN10, the general error code is stored in D92.

First Digit Error Codes

Error Code Display (Error Item)	User Program CRC Error	CRC Compari- son Code Keep Error	WDT Error	Power Failure
0 (no error)				
1				X
2			X	
3			X	X
4		X		
5		X		X
6		X	X	
7		X	X	X
8	X			
9	X			X
A	X		X	
B	X		X	X
C	X	X		
D	X	X		X
E	X	X	X	
F	X	X	X	X



Second Digit Error Codes

Error Code Display (Error Item)	User Program Syntax Error	Keep Data Sum Check Error	Program Sum Check Error	TIM/CNT Preset Value CRC Error
0 (no error)				
1				X
2			X	
3			X	X
4		X		
5		X		X
6		X	X	
7		X	X	X
8	X			
9	X			X
A	X		X	
B	X		X	X
C	X	X		
D	X	X		X
E	X	X	X	
F	X	X	X	X



Third Digit Error Codes

Error Code Display (Error Item)	User Program Writing Error	System Program Error
0 (no error)		
1		X
2	X	
3	X	X

Micro-1 Error Causes and Actions**Keep Data Sum Check Error**

If timer/counter data or internal relay on/off statuses stored in the base unit RAM have changed during a power failure, this error is detected when power is restored.

Power Failure

Power voltage is lower than the rated power voltage.

Timer/Counter Preset Value CRC Error

On starting operation, the CRC is executed on the timer/counter preset value data stored in the base unit RAM to verify with the stored CRC comparison codes. Discrepancies result in a CRC error.

User Program CRC Error

On starting operation, the CRC is executed on the user program to verify with the stored CRC comparison codes. Discrepancy results in a CRC error. Transfer a correct program to the PLC.

**User Program Syntax Error**

This error occurs when a syntax error is found in the user program.

User Program Writing Error

This error is detected when the user program is not correctly written into the base unit memory during program transfer. In addition, this error is also detected when a memory size other than 1K steps is selected using the FA series program loader.

WDT (Watchdog Timer) Error

The watchdog timer monitors the time required for one program cycle to detect abnormal repeating operation functions. It then alarms if the processing is not completed in a specific period of time.

Micro³ and Micro³C Error Codes***Operating Status, Output, and Error Indicators***

Error Items	Operating Status	Output	Error Indicator	Checked
Advanced instruction syntax error	Stop	OFF	ERR1 ON	Writing user program
Calendar/clock error	Maintained	Maintained	ERR1 ON	Any time
Data link connection error	Stop	OFF	ERR1 ON	Initializing data link
Keep data sum check error	Maintained	Maintained	OFF	Turning power on



Link communication error	Maintained	Maintained	OFF	Any time
Power failures	Stop	OFF	ERR1 ON *1	Any time
Protect output overload error	Maintained	Maintained *3	ERR1 ON	During operation
Sensor power overload error	Stop	OFF	ERR1 and ERR2 ON	Any time
TIM/CNT preset value CRC error	Maintained	Maintained	OFF	Starting operation
User program CRC error	Stop	OFF	ERR1 ON	Starting operation
User program execution error	Maintained	Maintained	ERR1 ON	During operation
User program sum check error	Stop *2	OFF	ERR1 ON	During operation
User program syntax error	Stop	OFF	ERR1 ON	Write user program
User program writing error	Stop	OFF	ERR1 ON	Write user program
Watchdog timer error	Stop	OFF	ERR1 ON	Any time



NOTE: *1: When the power voltage to the Micro³ or Micro³C drops below the rated value, the ERR1 indicator is lit. While the power voltage remains below the rated value, the ERR1 indicator does not go on.

*2: When a program sum check error occurs, operation is stopped momentarily to recompile the user program. After completing the recompilation, operation resumes.

*3: Outputs where the error occurs are turned off.

Error Causes and Actions

1h: Power Failure (Power Off)

This error indicates when the power supply is lower than the specified voltage. This error is also recorded when the power is turned off. Clear the error code using FUN20 on the program loader.

2h: Watchdog Timer Error (Watchdog Time)

The watchdog timer monitors the time required for one program cycle (scan time). When the time exceeds approximately 200 msec, the watchdog timer indicates an error. If this error occurs frequently, the Micro³ or Micro³C should be replaced. Clear the error code using FUN20 on the program loader

4h: Data Link Connection Error (PC Connect NG)

This error indicates that both data link slave stations (function selector switch set to 1–6) and an expansion station (function selector switch set to 7) are connected to the data link master station (function selector switch set to 0). Make sure that the function selector switches at all slave stations are set to 1–6 in the data link system. The expansion link function cannot be used in the data link system.



To correct this error, change the function selector switch setting to 1–6 on slave station units. Turn the power off and on again for the slave station unit. Then turn the power off and on for the master station unit. Or, execute the link formatting sequence (FUN27) for the master station using the program loader.

8h: User Program CRC Error (Users Prg. CRC)

This error indicates that the user program stored in the Micro³ EEPROM is broken. Transfer a correct user program to the Micro³ or Micro³C, and clear the error code using FUN20 on the program loader.

10h: Timer/Counter Preset Value CRC Error (TIM/CNT CRC)

This error indicates that the execution data of timer/counter preset values is broken. Clear the error code using FUN20 on the program loader, then the timer/counter preset values are initialized to the values of the user program. Note that modified preset values are cleared and the original values are restored when the error code is cleared.

20h: User Program Sum Check Error (Prg. Sum Check)

This error indicates that the data of the user program compile area in the Micro³ or Micro³C RAM is broken. When this occurs, the user program is recompiled automatically. Clear the error code using FUN20 on the program loader; then the timer/counter preset values are initialized to the values of the user program. Note that modified preset values are cleared and the original values are restored when the error code is cleared.



40h: Keep Data Sum Check Error (Keep Data Sum)

This error indicates that the data designated to be maintained during power failure is broken because of memory backup failure. Clear the error code using FUN20 on the program loader. Note that the *keep* data of internal relays and shift registers is cleared when the error code is cleared.

80h: User Program Syntax Error (Syntax)

This error indicates that the user program has a syntax error or that FUN1 through FUN10 are set incorrectly. Correct the user program or FUN settings, and transfer the corrected user program to Micro³. The error code is cleared when a correct user program is transferred.

When this error occurs, the error message is displayed with a type code and an address code of seven digits total.

100h: User Program Writing Error (EEPROM NG)

This error indicates a failure of writing into the Micro³ or Micro³C base unit EEPROM when transferring a user program or when setting user program protection. The error code is cleared when writing into the EEPROM is completed correctly. If this error occurs frequently, the Micro³ or Micro³C base unit should be replaced.

200h: Protect Output Overload Error (Transistor NG)

This error is issued when a protect transistor output is overloaded during operation. In this case, only the overloaded output is forced off. When this error occurs at the base station in the expansion link system, error indicator ERR1 is lit at the base station. When the error is at the expansion station, error indicator ERR1 is lit at both the base and expansion station.



If this error has occurred at output Q0 or Q20, then remove the cause of the overload; the output will then restore normal operation automatically. Clear the error code using FUN20 on the program loader.

400h: Sensor Power Overload Error (24V Overload)

This error indicates that the sensor power supply from the Micro³ is overloaded. Both error indicators ERR1 and ERR2 will be lit.

When this error occurs at the base station in the expansion link system, error indicators ERR1 and ERR2 are lit at the base station. When the error is at the expansion station, ERR1 and ERR2 are lit at both the base and expansion stations.

To correct this error, reduce the sensor power output load within the rated value. Then, either turn the power to the Micro³ off and on, or clear the error code using FUN20 on the program loader.

800h: Calendar/Clock Error (Calendar NG)

This error indicates that the real time calendar/clock in the Micro³ base unit has an error caused by invalid clock data due to a voltage drop or by erroneous quartz oscillator operation.

Clear the error code using FUN20, and set the calendar/clock data using FUN28 on the program loader. Turn the power off and on again. If the error continues, the Micro³ should be replaced.



Advanced Instruction Syntax Error (ADV Error)

NOTE: This option is applicable for the Micro³ only.

When a user program syntax error (error code 80h) is indicated with type code 5, 6, or 7 to signal an error related with advanced instruction, the detailed information can be viewed from the error code indicated by the ADV error line.

Error Code	Error Details
1	The internal allocation number of the operand is invalid.
2	Input or special internal relay is designated as a destination.
3	Quantity of repeat cycles is set to 32 (or shift bits to 16 for shift/rotate instructions) or more.
4	Advanced instruction which is not allowed for repeat usage is programmed more than once.

Correct the error in the user program, and transfer the corrected user program to Micro³. The error code is cleared when a correct user program is transferred.

Link Communication Error (COM Error)

This error indicates a communication error in the expansion link or data link system. When this error occurs, special internal relay M305 (link communication error) is also turned on. The detailed information of this error can be viewed from the error code indicated in the COM error line. This error code is stored in control data register D94, if it is enabled using FUN10. When this error occurs, program operation and all output statuses are maintained.



Error Code	Error Details
1h	Overrun error (data is received when the receive data registers are full)
2h	Framing error (failure to detect start or stop bit)
4h	Parity error (an error was found by the parity check)
8h	Receive time-out (line disconnected)
10h	BCC (block check character) error (disparity with the data received up to BCC)
20h	Retry cycle over (error occurred in all three trials of communication)
40h	I/O definition quantity error (error in the connection to the FA series PF3S-SIF4 serial interface module)

When more than one error is detected in the expansion link or data link system, the total of the error codes is indicated. For example, when a framing error (error code 2h) and a BCC error (error code 10h) are found, error code 12 is displayed.

User Program Execution Error (RUN Error)

This error indicates that invalid data is found during the execution of a user program. When this error occurs, special internal relay M304 (user program execution error) is also turned on. The detailed information of this error can be viewed from the error code indicated in the RUN error line. This error code is stored in control data register D93, if it is enabled using FUN10. When this error occurs, program operation and all output statuses are maintained.



Error Code	Error Details
1	As a result of an advanced instruction, a value exceeding 9999 is written into the timer/counter preset value. Data is written into the preset value of a timer/counter which is not included in the user program or which uses a data register as a preset value.
2	A data register used as a preset value for timer, counter, or counter comparison instruction exceeds 9999.
3	An indirect operand for the IMOV or IMOVN instruction is out of range.
4	Overflow or underflow has resulted from an advanced instruction.
5	Division by 0 is not possible.
6	Invalid data occurred during the data conversion of the DISP or DGRD instruction.
7	An attempt was made to write invalid value to calendar/clock data.
8	A data register used as an operand for the PULS or PWM instruction contains invalid data.
9	The quantity of multi-stage preset data for high-speed counter HSC1 exceeds the available data registers. An invalid numeric allocation number is designated as a comparison output of the HSC1.



Remove the cause of the error, and clear the error code using FUN20 on the program loader. Special internal relay M304 is reset when restarting the Micro³ or Micro³C operation or can also be reset using the program loader (MON, M304, RST, [ENTER]).

Master Error Lists for All PLCs

Ladder to Mnemonic Error List

These errors codes occur during the compilation of a ladder file.

Error #000	Vertical line not properly connected at the top A line must be connected to either another line, a coil, or a power rail.
Error #001	Vertical line not properly connected at the bottom A line must be connected to either another line, a coil, or a power rail.
Error #002	...not properly connected on the left An instruction or line must be connected to either another line, a coil, or a power rail.
Error #003	...not properly connected on the right An instruction or line must be connected to either another line, a coil, or a power rail.



Error #004	<p>Rung has more than one CNT/SFR</p> <p>Only one counter or shift register is allowed on each rung.</p>
Error #005	<p>...is not on the main line</p> <p>Some instructions (such as a counter) must be placed on the first line of a rung.</p>
Error #006	<p>Sub rung is empty</p> <p>Some instructions (such as a counter) require multiple inputs/outputs.</p>
Error #007	<p>A short-circuit ends at...</p> <p>WindLDR gives the approximate location of each end of the short-circuit.</p> <p>A short-circuit occurs when a path length is zero. A path is created by the connection of lines in a rung. A short-circuit occurs when a horizontal ladder line does not contain a contact. This error tells the user that a short-circuit exists before the given address.</p>



Error #008	<p>A short-circuit starts after...</p> <p>WindLDR gives the approximate location of each end of the short-circuit.</p> <p>A short-circuit occurs when a path length is zero. A path is created by the connection of lines in a rung. A short-circuit occurs when a horizontal ladder line does not contain a contact. This error tells the user that a short-circuit exists after the given address.</p>
Error #009	<p>A short-circuit exists in the area of...</p> <p>A short-circuit occurs when a path length is zero. A path is created by the connection of lines in a rung. A short-circuit occurs when a horizontal ladder line does not contain a contact. This error tells the user that a short-circuit exists in the given area of the rung. WindLDR cannot pin point the exact location of the short-circuit because of the different power flow of the ladder line.</p>



Error #010	<p>A short-circuit bypasses...</p> <p>WindLDR states the type of coil that is skipped by the short-circuit.</p> <p>A short-circuit occurs when a path length is zero. A path is created by the connection of lines in a rung. A short-circuit occurs when a horizontal ladder line does not contain a contact. This error tells the user that a short-circuit bypasses or goes around the given address.</p>
Error #011	<p>The left power rail is shorted to the right power rail</p> <p>The ladder line requires an input- or output-equivalent instruction.</p>
Error #012	<p>This is an illegal branch</p> <p>WindLDR does not support rungs of this format.</p>
Error #012 (continued)	<p>This error occurs because the user cannot branch in and out of an “AND” or “LOD AND” connection. The example above shows that this error occurs between I002 and I003.</p> <p>This error may also occur if attempting to use Bit Push (BPS), Bit Read (BRD), or Bit Pop (BPP) instructions with a PLC that does not support them (such as the FA series PLCs, currently).</p>



Error #013	<p>...is not followed by OUT instruction</p> <p>This instruction also requires an output-equivalent instruction.</p> <p>The user can be given possible output-equivalent instructions which can be used depending on their desired operations. Output equivalent instructions, which can be used are: OUT, CNT, TIM, SFR, SFRN, MCS, SET, RST, and JMP.</p>
Error #014	<p>...is not preceded by LOD instruction</p> <p>This instruction also requires an input-equivalent instruction.</p> <p>The user can be given possible input-equivalent instructions which can be used depending on their desired operations. Input-equivalent instructions, which can be used are: LOD, LODN, CC=, and CC>=.</p>
Error #015	<p>...is not LOD equivalent</p> <p>A rung must begin with an input-equivalent instruction: LOD, LODN, CC=, or CC>=.</p>
Error #016	<p>...cannot follow a LOD equivalent instruction</p> <p>This instruction is not valid here.</p> <p>Input-equivalent instructions cannot precede the following instructions: JEND, END, and MCR.</p>



Error #017	<p>Output area has no OUT equivalent instructions</p> <p>Each rung must end with an output-equivalent coil.</p> <p>There is more than one output instruction missing. Therefore WindLDR flags an error showing that there are no output-equivalent instructions in the rung. This error will occur if the rung is large and if there are multiple areas where there are no output-equivalent instructions.</p>
Error #023	<p>Input is shorted to the power rail.</p> <p>The LPR being connected to the RPR means that there is a direct path from the LPR to the RPR via only horizontal or vertical lines. This is not allowed in WindLDR.</p>

Communication Error List

See the *General Error Codes* on page A3 - 1.



Operand Error List

These error messages describe mistakes in the coil allocation or operand numbers.

Error #000	<p>Allocation number is not assigned</p> <p>Each instruction requires a valid allocation number.</p> <p>Refer to the <i>Allocation Table</i> in <i>Appendix 1</i> for more information.</p>
Error #001	<p>Operand for...has an invalid allocation number type</p> <p>The allocation number must be valid for the selected PLC and instruction.</p> <p>Refer to the <i>Allocation Table</i> in <i>Appendix 1</i> for more information.</p>
Error #003	<p>Preset value is not assigned</p> <p>This instruction requires a preset value that has been left blank.</p> <p>Some valid preset values are: TIM preset values: 0 – 9999 CNT, CDP, and CUD preset values: 0 – 9999 CC= and CC>= preset values: 0 – 9999 SFR and SFRN preset values: 1 – 128</p>
Error #005	<p>Operand for...cannot be a read only special internal relay</p> <p>This instruction cannot be assigned an operand of this type.</p> <p>Refer to the <i>Allocation Table</i> in <i>Appendix 1</i> for more information.</p>



Error #050	<p>Allocation number...is not an Up Counter number</p> <p>The allocation number is not valid for this instruction. Refer to the <i>Counters</i> reference in the on-line help.</p> <p>Refer to the <i>Allocation Table</i> in <i>Appendix 1</i> for more information.</p>
Error #051	<p>Allocation number...is not a Dual Pulse Counter number</p> <p>The allocation number is not valid for this instruction. Refer to the <i>Counters</i> reference in the on-line help.</p> <p>Refer to the <i>Allocation Table</i> in <i>Appendix 1</i> for more information.</p>
Error #052	<p>Allocation number...is not an Up/Down Counter number</p> <p>The allocation number is not valid for this instruction. Refer to the <i>Counters</i> reference in the on-line help.</p> <p>Refer to the <i>Allocation Table</i> in <i>Appendix 1</i> for more information.</p>
Error #100	<p>Constant out of range: Enter a constant between...and...</p> <p>See the instruction's reference page for more information.</p>
Error #101	<p>Preset value is out of range: Enter a value between...and...</p> <p>Enter a valid preset value. Some valid preset values are:</p> <p>TIM preset values: 0–9999</p> <p>CNT, CDP, and CUD preset values: 0–9999</p> <p>CC= and CC>= preset values: 0–9999</p> <p>SFR and SFRN preset values: 1–128</p>



Error #150	<p>Repeats are used, but repeat field is empty</p> <p>See the instruction's reference page for more information.</p> <p>This error code applies only to advanced instructions.</p>
Error #200	Allocation number is not assigned
Error #201	<p>Integer operand is not all integers.</p> <p>Enter only numeric digits, no alpha characters.</p>
Error #202	<p>Integer operand is out of DWORD range</p> <p>See the instruction's reference page for more information.</p>
Error #203	<p>Symbolic structure is not correct</p> <p>This error occurs when in an assigned field two or more letters are used with numbers in a field.</p> <p>See the instruction's reference page for more information.</p>
Error #204	<p>Unknown allocation number type character "..."</p> <p>Refer to the <i>Allocation Table</i> in <i>Appendix 1</i> for more information.</p>
Error #205	<p>Allocation number must be octal</p> <p>Refer to the <i>Allocation Table</i> in <i>Appendix 1</i> for more information.</p>
Error #206	<p>Allocation number is not valid for this PLC</p> <p>Refer to the <i>Allocation Table</i> in <i>Appendix 1</i> for more information.</p>
Error #207	<p>...instruction is not valid for...</p> <p>This instruction is not valid for this PLC. You must either</p>
	<p>PLC with which you are working with.</p> <p>See the instruction's reference page for more information.</p>



A

- AC Coupled Amplifier** An amplifier in which only AC signals are amplified, and DC signals are totally ignored.
- AC Input Module** Device which converts various AC input signals originating in the user's switches to the appropriate logic level required for use within the programmable logic controller.
- AC Output Module** Device which converts the low-voltage logic levels of the processor (CPU) to output signals for control of a user's field device or load.
- Access Time** The time interval between the instant at which information is: 1) Called for from storage and the instant at which delivery is completed, i.e. The read time; 2) Ready for storage and the instant at which storage is completed, i.e. The write time.
- Accumulator** A register in the logical-arithmetic section of the processor. It is commonly used for intermediate storage of arithmetic results or other intermediate operations.



Address	An identifying number which represents a location in the processor's memory. This number can also relate to the location of an I/O.
Algorithm	A prescribed set of rules for the solution of a problem in a definite number of steps, i.e. An algorithm for PID.
Alphanumeric	Used to identify a character set or data which consists of both letters and numbers.
Alternating Current (AC)	An electric current in which the charge-flow reverses direction at recurring intervals.
Ambient Compensation	The design of an instrument such that changes in ambient temperature do not effect the readings of the instrument.
Ambient Temperature	The temperature within an encompassed atmosphere.
Ampere (amp)	A unit of electrical current. One (1) ampere is the current which flows through one (1) ohm of resistance at one (1) volt potential.
Analog	Of or pertaining to the general class of devices in which the output varies as a continuous function of the input.



- Analog Data** Data represented in a continuous form, as contrasted with digital data represented in a discrete (discontinuous) form. Analog data is usually represented by physical variables (e.g., voltage, resistance, rotation, etc.)
- Analog Input Module** A device which converts an analog signal from a user's device into a digital signal for use by the processor.
- Analog Output Module** A device which converts a digital signal from the processor into an analog output signal for control of a user's field device.
- Analog/Digital (A/D) Converter** A device that changes a variable analog signal into a digital signal.
- AND** A logical operation which has the property such that if X and Y are two logic inputs, then the single output of X and Y is only ON when both X and Y are ON, as shown below (0=off, 1=on):

<u>X</u>	<u>Y</u>	<u>X&Y</u>
0	0	0
1	0	0
0	1	0
1	1	1



Annunciator	A visual device consisting of a number of pilot lights or buzzers. Each light or buzzer indicates the condition which exists or existed in an associated circuit.
ANSI	Abbr.= American National Standards Associations.
Apparent Power	Apparent power is the combination of reactive power and active power.
Application Program	A “PLC” or computer program that accomplishes specific tasks.
Arithmetic Capability	The ability to do arithmetic functions such as; addition, subtraction, multiplication, and division with the processor.
Armature	The laminated iron core with wire wound around it in which electromotive force is produced by magnetic induction in a motor or generator: usually a revolving part, but in AC machines (motors) often stationary.
Array	An arrangement of elements in one or more dimensions.
ASA	Abbr. = American Standard Association.



ASCII	Abbr.= American Standards Code for Information Interchanges. This is the code whereby E 8-bit configurations are defined for all alpha-numeric characters.
Assembly Language	A computer language that has one-to-one correspondence with an assembly program. The assembly program directs a computer to operate on a program in symbolic language (i.e. FORTRAN) to produce a program in machine language.
Asynchronous Shift Register	A shift register which is loaded and shifted only at data entry, no clock is required.
Asynchronous Transmission	A mode of data transmission where each character is preceded by a start bit and is terminated with a stop bit.
Automatic Reset	To automatically return a device to the "0" or off state after a given period of time, or condition.
Auxiliary Contacts	In a switching device, contacts, in addition to the main circuit contacts, which function with the movement of the latter.

B

Bandwidth	The frequency range in which the magnitude of the system gain expressed in db is within the 3 db band.
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Baud	A unit of data transmission, typically bits per second.
Baud Rate	Synonymous with signal events (bits) per second and used as a measure of serial data flow between a computer and/or communication
BCD (Binary Coded Decimal)	A notation system that represents each decimal as a four (4) bit binary code of “1” or “0”.

<u>BCD</u>	<u>DEC</u>
0000	0
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7
1000	8
1001	9

Binary Number System	A base 2 numbering system in which numbers are represented by “1’s” and “0’s”.
Binary Word	A related grouping of “1’s” and “0’s” whose meaning is determined by position, or whose numerical value is designated by the binary system of numbers.



Bipolar	Refers to transistors in which the working current consists of both positive and negative electrical charges and flows through two (2) types of CARRY, A condition occurring during addition when the sum of two digits in the same column exceeds the base. The carry digit is added to the next column.
Bit	A contraction of binary digit, the smallest unit of information in binary notation. A bit is a Zero (0) or a One (1).
Bit Rate	The rate at which binary digits, or pulses representing them, pass a given point of the communications line.
Block	A variable or fixed group of bits or words handled as a unit.
Block Diagram	A simplified schematic representing major electrical components.
Boolean Algebra	A logical algebra system, named after its inventor George Boole, that represents ON-OFF relationships symbolically as implied by the operators. (i.e. AND, OR, NOT)
Boolean Equation	An expression of relationships between logic functions.



Boot	The process of loading a program into the computer and bringing it up on the screen.
BPS	Abbr. = Bits Per Second.
Bounce Filter	The electronic circuitry used to eliminate the effects of contact bounces within a mechanical switching device.
Branch	An instruction which then executed may cause the arithmetic and control unit to obtain the next instruction from some location other than the next sequential location. (See JUMP). 2) A point in a program where there may be alternative paths of instructions.
Bridge Rectifier	A full-wave rectifier that conducts current in only one direction of the input signal (current). AC voltage applied to the input results in the approximate DC voltage at the output.
BTU	Abbr. = British Thermal Unit
Buffer	A storage device for temporarily holding of data. Alternately, can also be defined as a circuit inserted between circuits to perform an isolating function.
Bus	A channel, wire, or line along which data can be sent or received, e.g. Address bus or Data bus.



Byte A group of adjacent bits (usually eight [8]) operated on as a unit.

C

Cartridge Tapeloader-Recorder A magnetic tape recording and playback device for entering or storing programs, data, or both.

Cascade A group of registers arranged in succession so that each segment is derived from or acts on the preceding register.

Central Processing Unit (CPU) The component of the PLC, often referred to as the processor, that contains the primary memory, performs math and logic operations, and executes the user's program.

Channel A path for electrical transmission of signals between two or more points.

Character A symbol (such as; a letter or number) that represents information.

Checksum The sum of a group of data items associated with the group for checking purposes.

Clear To return the contents in a storage (registers) unit to zero.

Clock A pulse generator which synchronizes the timing of various logic circuits and memory in the processor (CPU).



Coaxial Cable	A cable consisting of an outer conductor concentric to an inner conductor, separated from each other by a dielectric material.
Code	A system of symbols (bits) used to represent data (characters).
Computer Interface	A device designed for data communications between a central computer and a programmable logic controller (PLC).
Conditional Jump	A jump instruction that is subject to the result of a comparison made within the program.
Copy	To read data from a source, leaving the source data unchanged, and to write the same data elsewhere in a form that may differ from that of the source.
Core Memory	A device used to store information in ferrous cores, which may be magnetized in either polarity to represent a logical “1’s” or “0’s”. This type of data memory is read/write and is nonvolatile.
Counter	A location internal to the processor (CPU) which can be set to an initial number and increased and/or decreased.
CRT Terminal	A cathode ray tube used to display various information, ladder programs, data lists, and application reports. (See data terminal)



- Current Loop** A method of transmitting data that utilizes the presence and absence of current pulses.
- Cursor** A symbol on a CRT screen that indicates the next position that a character will be written.
- Cycle** 1, One completion of a sequence of operations. 2, The interval of time to terminate a sequence of operation.

D

- Daisy Chain** Term that represents the method of wiring the same signal to several devices.
- Data** A general term for any type information processed by a computer or a programmable logic controller.
- Data Link** Equipment, especially transmission cables and interfaces, which complete the communications connections and permitting the transmission of data.
- Data Processing** A procedure for collecting data, acting on it, and producing a specific result.
- Data Set** A device that converts the signals of a data terminal to signals that are suitable for transmission over communication lines. (See Modem).



Data Terminal	A device where a programmable logic controller's or computer's memory data can enter or leave the system, (See CRT Terminal).
Debugging	The identification and elimination of mistakes in hardware (wiring equipment) and the software (user's program).
Decoder	The circuitry used to interpret data and detect an individual address.
Diagnostic Program	A test program within the processor, or user memory used to help isolate hardware and/or software malfunctions within the PLC.
Differential	See RS-422.
Digital Data	Data represented in discrete, discontinuous form, as contrasted with continuous analog data. Digital data is usually represented by means of coded characters (e.g., numbers, signs, symbols, etc.)
Digital to Analog Converter	A device which transforms digital data into analog data.
Disabled	A program interruption to a sequence line, preventing normal operation of that sequence.



Discrete	1) Separate and complete. 2) Pertaining to data in the form of distinct elements or physical quantities, having distinctly recognizable values. Digital = ON or OFF. I/Os are often referred to as discrete I/Os.
Disk Drive	A memory system which uses a rotating magnetic disk to store data or information.
Documentation	An orderly collection for the purpose of authenticating hardware and software information.
Double Precision	Data requiring two words or registers to process because of data requirements.
Dump	The process of putting the contents of memory on a magnetic tape or disk.
Duplex	Two-way data transmission. Full-duplex allows simultaneous data transmission in both directions. Half-duplex allows data transmission in either Direction, But Only One Direction At A Time.
Dynamic Display	A CRT screen display which is continuously updated.



E

EEPROM	Abbr.= Electrically Erasable and Programmable Read Only Memory. A read/write non-volatile type of memory which uses electrical charges to maintain the program and reprogram.
Edit	To deliberately modify the user's program in the processor's memory.
Element	An individual component within a programmable logic controller's program.
Encode	To convert data by the use of a code in such a manner that re-conversion to the original form is possible.
EPROM	Abbr.= Erasable Programmable Read Only Memory. A nonvolatile memory which requires approximately a 30 minute exposure to a ultra-violet light in order to be reprogrammed.
Error	1) The difference in value between actual response and the desired response in the performance of a controlled machine, system, or process. 2) An indication of a problem with hard-ware or software within the programmable logic controller.
Escape	The process of returning to the previous mode of operation.



Execution The performance of a specific operation as accomplished through processing programmed instructions.

Execution Time The total time required to complete the execution of the specific operation.

F

Failure The termination of the capability of a functional unit to perform its required function. A failure is the effect of a fault.

Fault An accidental condition that causes a functional unit to fail or to perform in the required manner.

Fault Current The maximum electrical current, far in excess of normal current, that will flow in a short-circuited system prior to the actuating of any current-limiting device.

Feedback The signal or data returned to the programmable logic controller from a controlled machine or process to indicate its response to the control signal.

File An organized collection of documents or data.

Filter A device used to suppress electrical noise.

Firmware A series of instructions for internal use by the processor only.



Fixed Point	A notation of numbers where all numeric quantities are expressed by a set of digits with the decimal point implicitly located at some predetermined position.
Floating Point	A form of number representation where decimal points are not fixed by the length of the number, itself, but are implicit.
Flow Chart	A graphic diagram used to represent the function of a system or sequence of operations, using symbols to represent the logical data flow.
Full-Duplex	Simultaneous two-way data transmission through a communications channel.

G

Graphics	Methods and techniques for converting data to and from a graphic display.
Grey Code	A binary code in which sequential numbers are represented by binary expressions, each of which differs from the preceding expression in one place only.


H

Half-Duplex	Two-way, but not simultaneous, transmission of data through a communications channel.
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Hard Copy	A permanent, printed document such as a ladder diagram program listing.
Hardware	The mechanical, electrical, and electronic device's which compose a programmable logic controller system and it's application.
Head	A device, usually a small electromagnet, on a storage medium, such as magnetic tapes, that reads, records, or erases information on to that medium.
Hexadecimal	A number system of the base "16", comprised of the digits, "0", "1", "2", "3", "4", "5", "6", "7", "8", "9", "A", "B", "C", "D", "E", and "F".
I	
I/O	Abbr. = Input and Output.
I/O Capability	Typically references the maximum quantity of inputs and outputs that a programmable logic controller can accommodate.
I/O Modules	1) Input cards (modules) convert the higher field input voltages required for the field device to the low-level input signal used by the processor. 2) Output cards (modules) convert the low-level processor control signals to a usable level for field devices.



I/O Frame	A device that houses a quantity of I/O modules, referred to as the I/O RACK.
I/O Scan	A procedure the processor follows to monitor inputs and control the output devices.
Inhibited	Pertaining to a state of processing unit in which certain operations are not allowed to occur.
Initialize	To set to a starting position.
Input	The data supplied to a programmable logic controller for processing.
Input Devices	Devices such as limit switches, pressure switches, operator push buttons, etc., that supply data to the programmable logic controller. Other inputs include analog devices and digital encoders.
Instruction	A set of bits which will generate certain prescribed operation to be performed by the programmable logic controller.
Interface	A device that allows communications between systems or ports of different systems.
Interlock	To arrange the control of machines or devices so their operation is interdependent in order to assure their proper coordination.
 Interrupt	To temporarily disrupt the normal sequence of events on command.

Isolated I/O Refers to digital I/O, where the devices are on a different voltage sources, i.e. Each I/O has a separate return (ground) line.

Isolation The voltage difference between external devices and the controller logic incorporated in the I/O modules for rejection of electrical noise.

J

Jitter Undesirable vibration on a display image on a display surface.

Jump A command to go from one sequence of instructions to another.

Jumper A short length of wire used to close a break and make a connection between terminals in a circuit.

L

Ladder Diagram An industry standard-for symbolically representing control logic relay systems.

Language A formal system of symbols and rules to express and communicate information (data) between people and machines.

Least Significant Digit The digit in a numbering system which represents the smallest value.



Left Justified	1) A field of numbers which have no zero's (0's) to its left. 2) An element re-positioned to the upper-left most location possible of the programming matrix.
Line Printer	A high-speed output device that prints an entire line of characters as a unit.
Load	1) A device placed in a circuit to which power is delivered. 2) The process of entering data into the processor's memory.
Location	A storage position in memory uniquely specified by an address.
Local I/O	1) Physically mounting the I/O frame (rack) in close proximity to the processor. 2) The term used for the I/O modules mounted within the same I/O frame (rack) as the processor.
Logic	A means of solving complex problems through the repeated use of simple functions which define basic concepts. The three (3) basic logic functions are "AND," "OR," and "NOT".
Logic Level	The voltage magnitude associated with signal pulses representing ones (+5 vdc) and zeros (0 vdc).
Loop	The repeated execution of series of instructions for a fixed number of times.



M

Magnetic Core	A device used for storing a bit of information in a programmable logic controller. (See core memory)
Magnetic Tape	A ribbon of plastic coated tape for use in magnetic recording, used to store information.
Matrix	A logic network in the form of a array of inputs leads and outputs leads with logic elements providing inter-connections.
Medium Scale Integration	Any integrated circuit which has, between 12 and 100 equivalent gates.
Memory	A device in which data is stored and may be retrieved.
Memory Module	A modular card consisting of a memory circuit and is capable of storing a finite number of words.
Micro-Processor	The central processing unit implemented in relatively few integrated circuits which contain, Arithmetic, Logic, Register, and Memory functions.
Microsecond	One millionth of a second; 1×10^{-6} or 0.000001 second.
Millisecond	One thousandth of a second; 1×10^{-3} or 0.001 second. Also expressed as "1ms".
Mode	A method of operation, i.e. programming mode, search mode, etc.



Modem	Abbr. = MOdulator DEModulator. Used to describe the device applied to convert terminal information for communications over telephone lines, or other communications medium.
Monitoring Control	A central programmable logic controller used in an application where the process is continually checked so that the operator may be alerted to possible malfunctions.
Most Significant Digit	The digit in a numbering system that represents the greatest value.
Multiplexing	The process of transmitting multiple signals from different sources over a common cable or transmission line by causing.

N

Natural Binary	A number system to the base of two (2), in which the ones (1) and zeros (0) have a weighted value in accordance with their relative position in the binary word.
NEMA Standards	Property characteristics adopted as the standard by the National Electrical Manufactures Association.
Noise	An extraneous signal in a electrical circuit capable of interfering with the desired signal.



Nonvolatile Memory A memory that retains it's information when power is lost or removed.

O

Octal Numbering System A base eight (8) numbering system where only the digits 0 through 7 are used.

Off-Line Describes equipment or devices which are not involved in direct communications with the programmable logic controller.

Ohm's Law Currents (I) in terms of electromotive force (E) and resistance (R) given in the equation; $I = E/R$.

On-Line Describes equipment or devices which are involved in direct communications with the programmable logic controller.

On-Line Operation That time when the programmable logic controller is scanning the inputs and updating the outputs accordingly.

Opto-Isolator A logic device using light and a photo-detector as a isolator.

OR A logic operation having the property that if A and B are logic inputs, then the single output of A and B will only be ON if at least one of the two is ON, as shown below (0=off, 1=on):



<u>A</u>	<u>B</u>	<u>A or B</u>
0	0	0
0	1	1
1	0	1
1	1	1

Output

Information transferred from the programmable logic controller to a output device or to external storage.

Output Devices

Devices such a solenoids, motor starters, etc., that receive their controlling signal from a programmable logic controller.

Overflow

In an arithmetic operation, the generation of a quantity beyond the capacity of the storage register of location, which is to receive the result.

P**Parallel Operation**

Type of information transfer where by all bits of a word are handled simultaneously.

Parallel Output

Simultaneous availability of two or more bits, channels, or registers.

Parity Bit

A binary digit appended to a array of bits to make the sum of all the bits always odd or always even.



Parity Check	A diagnostic check that tests whether the numbers of ones (or zeros) in a array of binary digits is ODD or EVEN. Typically performed on words in memory to insure they have not been altered in storage or transmission.
PC	Abbr. = Programmable Controller and/or Personal Computer.
Peripheral	Equipment used to input or receive output data from a system. Typically printers, color operator interfaces (CRT's), act.
Pilot Type Device	An electromechanical switch or set of relay contact, which energizes a control circuit which in turns energizes a high current load.
PLC	Abbr.= Programmable Logic Controller.
Port	A communication channel between devices.
Precision	The degree of discrimination with which a quantity is stated, e.g., A three digit numeral discriminated among 1000 possibilities. Precision is contrasted with accuracy.
Printed Circuit	A board on which a predetermined pattern of printed connections has been formed.



- Processor** A unit in the programmable logic controller which scans all the inputs and outputs in a predetermined order. The processor monitors the status of all the I/Os in response to the user's programmed instructions, stored within the memory, and energizes or de-energizes outputs as the result of logical comparisons made through these programmed instructions.
- Program** A sequence of instructions to be executed by the programmable logic controller, to control a machine or process.
- Programmable Logic Controller** A solid state control system which has a user programmable memory for storage of instructions to implement specific functions such as; I/O control logic, timing, counting, arithmetic, and data manipulation. A PC or PLC consists of a Central Processing Unit (CPU), I/O interface modules, memory, and a programing device. A PC (PLC) was purposely designed as an industrial control system.
- PROM** Abbr.= Programmable Read Only Memory. A digital storage device which can be written into once, but continually read.



Protocol A standardized procedure for establishing a communications link between two or more devices based on such elements as word structure and length.

Pulse A brief voltage or current surge of a measurable duration.

R

RAM A Random Access Memory in a addressable LSI device, used to store information (data). This memory is a “Read/Write” and is volatile.

Read To copy, usually from one form of storage to another, particularly from external or secondary storage to internal storage. To sense the presence of information on a recording device or medium.

Real Time Pertaining to the performance of a computation during the actual time that a related physical process transpires, in order that the results of the computation can be used in guiding the physical process.

Register A memory device capable of containing one or more computer bits or words.

Remote I/O The capability of locating an I/O frame (rack) long distances from the processor’s rack.



Right Justified	Term applied to a field of numbers which exists in a memory cell, location, or register, possessing no significant zeros (0) to its right.
ROM	Abbr.= Read Only Memory, a nonvolatile digital storage device specified for a single function. Data is permanently loaded into a “ROM” memory, and is available whenever needed.
Routine	A series of computer instructions which performs a specific limited task every time it is called up.
Rung	A grouping of PLC instructions (symbols) which controls an output. This is represented as one section of a ladder logic diagram.
RS-232-C	An E.I.A. (Electronic Industries Association) standard, covering the electrical and mechanical requirements for serial transmission between terminal devices. Because a voltage signal is utilized RS-232C signals are limited to short distances (approximately 60 feet) due to the voltage drop of the wires.
RS-422	An E.I.A. (Electronic Industries Association) standard, covering the electrical and mechanical requirements for serial transmission between terminal devices. RS-422 relies on the difference between two potentials, allowing the sending and receiving devices to have different electrical



grounds, thereby allowing for long (up to two (2) miles) communication distances.

(Also, Differential)

S

Scan Time

The time necessary to completely execute the entire programmable logic controller's programmed instructions one time.

Schematic

A diagram of a circuit in which symbols illustrate circuit components.

SCR

Abbr.= Silicon Controlled Rectifier. A solid state three (3) terminal device which employs a control signal to switch a DC voltage load. Also known as a THYRISTOR.

Serial Operation

A type of information transfer within a programmable logic controller whereby the bits are handled sequentially rather than simultaneously, as they are in a parallel operation. Slower than parallel for the equivalent clock rate. However, only one (1) channel or wire is required for serial operation.

Setpoint

The required or ideal value of a controlled variable, usually preset in the system's controller by the operator.



Shift	To move information serially right or left in the register(s) within the programmable logic controller.
Shift Register	A storage area for bits in which the information is input by shifting bits or bit patterns in either direction. Representing some sequence of events, as opposed to numerical values. Can be operated either synchronously or asynchronously.
Sign	The symbol or bit which distinguishes the positive or the negative value of a given number.
Significant Digit	A digit that contributed to the precision of a numeral. The number of significant digits is counted, beginning with the digit contributing the most value, called the significant digit and ending with the least significant digit.
Software	The user program which controls the operation of a PLC.
Solid State Devices	Electronic components that control electron flow through solid materials such as crystals, transistors, diodes, and integrated circuits.
State	The logic “0” (OFF) or “1” (ON) condition in the PLC’s memory or at a circuit’s input or output module.



Static	Non-moving electrical charge, such as on the plates of a capacitor.
Status	The ON or OFF condition of the referenced device.
Storage	Synonymous with “MEMORY”.
Surge Suppressor	A series “RC” network attached to an I/O module for the purpose of limiting the electrical noise generated by inductive loads connected via hard contacts. Typically wired in parallel with the inductive load.
Synchronous Shift Register	A shift register which uses a clock for timing of a system operation and where only one (1) state change per clock pulse.
Synchronous Transmission	Having a constant time interval between successive bits, characters, or words.

T

Table	A collection of data, each item being uniquely identified either by some label or by its relative position.
Tape Reader	A unit which is capable of sensing data punched tape.



Teletype	A registered trademark of a type of printer terminal and tape reader, which was originally manufactured by the “TELETYPE CORP.”
Terminal	Any fitting attached to a circuit or device for the convenience in making electrical connections.
Terminator	A hardware load employed on the end of a transmission line or cable, used to balance the impedance.
Thumb-Wheel Switch	A rotating switch used to input numerical (BCD) information to the programmable logic controller.
Thyristor	See SCR.
Timeshare	A term applied to a computer which is servicing the needs of numerous users simultaneously.
Transceiver	A PLC component that allows communications to remote I/O racks. It converts the data from parallel communications used in the local configuration to serial communications.
Transducer	A device used to convert physical parameters such as temperature, pressure, and weight into electrical signals.
Transfer Module	A unit which supplies processor redundancy by switching program control automatically from one processor to another in the event of a failure of the



first (primary) processor. Provides automatic and instantaneous backup for critical control or process systems.

TTL

Abbr.= Transistor Transistor Logic. A family of integrated circuit logic employing multiple emitter transistors for rapid switching, operating in the range of 0 to 5 vdc.

U**UV Prom**

Abbr.= Ultraviolet Programmable Read Only Memory. A non-volatile memory which requires approximately a 30 minute exposure to ultraviolet light in order to be reprogrammed.

V**Volatile Memory**

A memory that loses it's information if the power is removed.

W**Word**

A set of bits comprising the smallest addressable unit of information within the programmable logic controller.

Word Length

The number of bits in a word.

Write

To enter data into a storage device.



Z**Zero Suppression**

The elimination of non-significant zeros in a number.

Zener Diode

A solid state voltage regulator for semiconductor devices.



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